

PREDICTING PRESSURE ULCER OCCURRENCE AND SEVERITY IN THE FIRST  
THREE YEARS FOLLOWING SPINAL CORD INJURY

A Dissertation

by

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## ABSTRACT

The purpose of the present study was to examine the role of depression and anxiety in predicting time to pressure ulcer occurrence and time to severe pressure ulcer occurrence during inpatient spinal cord injury (SCI) rehabilitation and in the first 3 years post-discharge. Participants were veterans with SCI who were admitted for initial inpatient rehabilitation to the Michael E. DeBakey VA Medical Center (MEDVAMC). Survival analysis was employed to assess time to pressure ulcer occurrence and time to severe pressure ulcer occurrence as a function of depression and anxiety. The sample included 82 veterans with SCI who were admitted to the MEDVAMC for inpatient rehabilitation between 2008 and 2011. Pressure ulcer occurrence and severe pressure ulcer occurrence were measured during inpatient rehabilitation and at years 1, 2, and 3 post-discharge. Veterans with higher scores on somatic items of depression had shorter severe ulcer-free survival times. For veterans without a pressure ulcer during inpatient rehabilitation, there was a statistically significant trend for endorsement of symptoms of depression and trauma-related anxiety to predict ulcer-free survival post-discharge. Additionally, those with higher scores on the somatic depressive items at admission and on the non-somatic depressive items at discharge had shorter severe ulcer-free survival times. The results offered partial support for the hypotheses of the present study. It can be concluded that providing mental health services during and after initial inpatient rehabilitation has the potential to improve both mental and physical health for veterans with SCI, while also saving the VA health care system millions of dollars.

## DEDICATION

My dissertation is dedicated to Best Buddies International.

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## TABLE OF CONTENTS

	Page
ABSTRACT .....	ii
DEDICATION .....	iii
ACKNOWLEDGEMENTS .....	iv
TABLE OF CONTENTS .....	v
LIST OF FIGURES.....	vii
LIST OF TABLES .....	viii
CHAPTER I INTRODUCTION.....	1
Secondary Conditions .....	1
Pressure Ulcers.....	2
SCI, Depression, and Anxiety .....	3
Purpose of the Present Study.....	4
CHAPTER II LITERATURE REVIEW.....	7
Spinal Cord Injury.....	7
Psychological Adjustment.....	9
Secondary Conditions .....	12
Methodological Issues.....	26
CHAPTER III METHODS.....	31
Participants .....	31
Procedures .....	35
Measures .....	37
Statistical Analysis .....	40
CHAPTER IV RESULTS.....	43
Psychological Assessment Information .....	43
Associations with Pressure Ulcer Occurrence .....	46
Survival Analysis .....	47

Summary of Results .....	52
CHAPTER V CONCLUSIONS .....	56
Limitations and Future Research.....	65
Improving Health Care for Individuals with SCI.....	69
REFERENCES.....	74
APPENDIX .....	88

## LIST OF FIGURES

	Page
Figure 1 Rate of Depression at Admission and Discharge .....	88

## LIST OF TABLES

	Page
Table 1 Life Table Analysis Assessing Injury Completeness in Predicting Time to Pressure Ulcer ( $n = 82$ ).....	89
Table 2 Life Table Analysis Assessing Race/Ethnicity in Predicting Time to Severe Pressure Ulcer ( $n = 82$ ).....	90
Table 3 Cox Regression Analyses Assessing Psychological Variables in Predicting Time to Severe Pressure Ulcer ( $n = 82$ ) .....	91
Table 4 Life Table Analysis Assessing Injury Level in Predicting Time to Pressure Ulcer ( $n = 40$ ) .....	92
Table 5 Life Table Analysis Assessing Injury Level in Predicting Time to Severe Pressure Ulcer ( $n = 40$ ).....	93
Table 6 Life Table Analysis Assessing Discharge Depression Status in Predicting Time to Pressure Ulcer ( $n = 40$ ) .....	94
Table 7 Cox Regression Analyses Assessing Psychological Variables in Predicting Time to Pressure Ulcer ( $n = 40$ ) .....	95
Table 8 Cox Regression Analyses Assessing Psychological Variables in Predicting Time to Severe Pressure Ulcer ( $n = 40$ ) .....	96



## CHAPTER I

### INTRODUCTION

It is estimated that there are approximately 273,000 people with spinal cord injury (SCI) currently living in the U.S., with 12,000 new cases added each year. Depending on the level of the injury, average yearly expenses per individual range from \$41,393 to \$181,328. Life expectancy for individuals with SCI is much lower than for individuals without SCI, especially in the first year post-injury, but it is important to note that medical advances have created changes in the leading causes of death for individuals with SCI. Whereas renal failure had been the leading cause of death, now pneumonia and septicemia have the largest impact on the life expectancy of individuals with SCI (National Spinal Cord Injury Statistical Center, 2013). Cases of septicemia that result in death in individuals with SCI are often associated with common secondary conditions, such as urinary tract infections and pressure ulcers (National Spinal Cord Injury Statistical Center, 2012), making it important to increase understanding of secondary conditions, their risk factors, and how they can be prevented.

#### **Secondary Conditions**

Although there is not one, agreed upon definition of secondary conditions, most definitions are broad and encompass more than physical complications. For example, in 1991, secondary conditions were defined as “any additional physical or mental health condition that occurs as a result of having a primary disabling condition” (Pope & Tarlov, 1991, p. 35). Almost 20 years later, an extended definition asserted that

secondary conditions are “the medical, social, emotional, mental, family, or community problems that a person with a primary disabling condition likely experiences” (United States Department of Health and Human Services, 2010, p. 26). Specific examples of secondary conditions commonly experienced by individuals with SCI include pressure ulcers, urinary tract infections, contractures and spasticity, pain, sexuality and reproductive health issues, related head injuries, and obesity (Warren, Williamson, Erosa, & Elliott, 2013). The present study focuses on one specific secondary condition and its psychological predictors.

### **Pressure Ulcers**

Pressure ulcers develop when restricted blood flow causes oxygen depletion and tissue damage. For example, the pressure of an individual’s weight pressing up against a wheelchair seat or mattress can result in a pressure ulcer (Burns & Hammond, 2009). Pressure ulcers are one of the most common secondary conditions (Richards, Waites, Chen, Kogos, & Schmitt, 2004) and have been the focus of a great deal of research, resulting in the identification of over 200 possible risk factors (Byrne & Salzberg, 1996). There is strong evidence that level of injury is not a risk factor for pressure ulcer onset (Gelis et al., 2009). Longitudinal research has shown that level of injury (i.e., tetraplegia vs. paraplegia) does not have an effect on pressure ulcer occurrence (Chen, DeVivo, & Jackson, 2005; McKinley, Jackson, Cardenas, & DeVivo, 1999), which has been a surprising finding for many researchers due to the physical differences between individuals with tetraplegia and individuals with paraplegia. These findings, coupled with steady pressure ulcer frequency and recurrence in the face of researchers’ focus on

physical explanations, have been quite helpful in that they have prompted discussion and research concerning psychological risk factors for pressure ulcers (Graham, 1997).

However, it has been suggested that the level of evidence to support psychological factors as risk factors for pressure ulcer occurrence is insufficient and that additional research is needed (Gelis et al., 2009).

The earliest research on psychological risk factors for pressure ulcers was conducted in 1979 and revealed that pressure ulcer incidence was directly related to psychological factors, but not directly related to mechanical factors (Anderson & Andberg, 1979). In the 35 plus years since then, additional research has followed, examining different psychological predictors, such as social support and problem-solving abilities. However, most of the research in the area has focused on depression as a risk factor for pressure ulcers. Much of the research has been cross-sectional, making it difficult to understand the relation between depression and pressure ulcers, but there has been a call for longitudinal designs. Moreover, despite high rates of anxiety in individuals with SCI, research considering anxiety as a potential predictor of pressure ulcers has been limited.

### **SCI, Depression, and Anxiety**

Not all individuals with SCI will experience depression or anxiety post-injury, but depressive disorders are the most common form of psychological distress following SCI and occur more frequently in the SCI population than in individuals who do not have disabilities (Elliott & Frank, 1996). Using the Patient Health Questionnaire-9, estimates of the prevalence of major depressive disorder range from about 11% or 12%

(Arango-Lasprilla, Ketchum, Starkweather, Nicholls, & Wilk, 2011; Bombardier, Richards, Krause, Tulskey, & Tate, 2004) to 21% (Hoffman, Bombardier, Graves, Kalpakjian, & Krause, 2011) 1 year post-injury and from about 10% (Arango-Lasprilla et al., 2011) to 18% (Hoffman et al., 2011) 5 years post-injury. Less research has been conducted on anxiety disorders, but it is estimated that between 13% and 40% of individuals with SCI will develop an anxiety disorder in the first 2 years post-injury (Craig, Tran, & Middleton, 2009).

Although individuals with SCI who have depression or anxiety constitute a minority of the SCI population, paying attention to these individuals is important. Depression in individuals with SCI is associated with several problematic behaviors, such as fewer hours out of bed, fewer days out of the house, less engagement in productive activities, and less planned exercise (Saunders, Krause, & Focht, 2012; Tate, Forchheimer, Maynard, & Dijkers, 1994). Less is known about the impact of anxiety, but it has been suggested that anxiety may result from the changes associated with injury and may motivate individuals to engage in health and self-care behaviors (Richards, Kewman, Richardson, & Kennedy, 2010).

### **Purpose of the Present Study**

The purpose of the present study was to fill in the gaps in the pressure ulcer risk factor literature. Although over 200 pressure ulcer risk factors have been identified and studied, more research is needed in the area of psychological predictors. Depression is the central focus in this area, though the limited study of anxiety has revealed interesting results as well. However, the frequent use of cross-sectional designs and the lack of

novel statistical approaches, such as survival analysis, have prevented this area of research from moving forward. The present study examined depression and anxiety as predictors of time to pressure ulcer occurrence, as well as time to severe pressure ulcer occurrence, in veterans with SCI during initial inpatient rehabilitation and the first 3 years post-discharge from initial inpatient rehabilitation.

In a previous study of veterans with SCI seen at the Michael E. DeBakey Veterans Affairs Medical Center (MEDVAMC), where the present study was conducted, almost 39% were treated for at least one pressure ulcer during the 3-year study period. The patients who met the inclusionary criteria for participation had an average of almost 4 pressure ulcers. Stage 4 pressure ulcers were most prevalent and most of the pressure ulcers had not healed by the end of the 3-year study period. Over half of the participants were hospitalized at least once for pressure ulcer treatment during the study, and almost 30% of participants were admitted three or more times. These participants did not differ from the other veterans with pressure ulcers in demographic or injury-specific factors (Garber & Rintala, 2003), suggesting that other factors likely influenced the severity of the pressure ulcers and their need for repeated hospitalization.

The aim of the present study was to examine the impact of depression and anxiety as predictors of time to pressure ulcer occurrence and time to severe pressure ulcer occurrence in a sample of veterans with SCI during initial inpatient rehabilitation and the first 3 years post-discharge from initial inpatient rehabilitation. Electronic medical records for veterans admitted to the MEDVAMC for initial inpatient SCI rehabilitation from 2008 to 2011 were reviewed and pressure ulcer occurrence and

severity were recorded for the duration of inpatient rehabilitation and the first 3 years post-discharge. Survival analysis was used to measure the time from SCI onset to pressure ulcer occurrence and from SCI onset to severe pressure ulcer occurrence (i.e., stage 3 or stage 4), as well as the explanatory role of depression and anxiety in predicting these outcomes. Survival analysis measures the time from a starting point to the occurrence of an event, such as the time from diagnosis of a disease to death. Survival analysis is more fitting than standard statistical techniques because the distribution is hardly ever normal and the data are frequently censored; the data are censored when the event does not occur during the follow-up time (Bewick, Cheek, & Ball, 2004). It was hypothesized that there would be statistically significant differences in time to pressure ulcer occurrence and time to severe pressure ulcer occurrence between veterans with and without depressive and anxious symptoms.

## CHAPTER II

### LITERATURE REVIEW

#### **Spinal Cord Injury**

It is estimated that there are approximately 273,000 people with spinal cord injury (SCI) currently living in the U.S., with 12,000 new cases added each year (National Spinal Cord Injury Statistical Center, 2013). Of the more than 250,000 individuals with SCI, it is estimated that about 42,000 are veterans who are eligible for medical care and benefits from the Department of Veterans Affairs (VA). The VA has the largest network of SCI care in the nation; in 2008, the VA provided SCI specialty care to 13,000 veterans and a full range of care to 26,000 veterans with SCI. The VA's SCI services are comprehensive and include vocational, psychological, and social services (Department of Veterans Affairs, 2009).

The spinal cord is the system that communicates almost all functional activity from the brain to the rest of the body and is divided into the cervical, thoracic, lumbar, and sacral regions (Warren et al., 2013). SCI can result from trauma or disease; after SCI occurs, nerves above the injury level continue to work as they did previously, but at the point of injury and below, spinal cord nerves can no longer send messages between the brain and other parts of the body. Thus, an individual's SCI is described by its level and its type. The level refers to the lowest point on the spinal cord below which there is a decrease in or absence of sensation and/or movement (University of Alabama at Birmingham Spinal Cord Injury Model System, 2000). Tetraplegia refers to loss of

sensory and/or motor function in the cervical segments, and impairment in the arms, trunk, legs, and pelvic organs. Paraplegia refers to loss of sensory and/or motor function in the thoracic, lumbar, or sacral (but not cervical) segments, and impairment in the trunk, legs, and/or pelvic organs, depending on the level of the injury (Kirshblum et al., 2011).

The type of injury refers to whether the SCI is complete or incomplete. The American Spinal Injury Association (ASIA) provides standards for the neurological classification of SCI. Specifically, injuries are classified as being neurologically complete or incomplete based on the sacral sparing definition, which refers to the presence of sensory or motor function in the lowest sacral segments (i.e., S4-S5) as determined by examination. When sacral sparing is absent and there is no sensory or motor function in the lowest sacral segments, the injury is classified as complete. When sacral sparing is present and there is some preservation of sensory and/or motor function in the lowest sacral segments, the injury is classified as incomplete. The ASIA Impairment Scale (AIS) is used to designate the degree of impairment. AIS A refers to a complete injury with no sensory or motor function in the sacral segments S4-S5. AIS B refers to a sensory incomplete injury with preservation of sensation, but no preservation of motor function, below the neurological level, which includes the sacral segments S4-S5. AIS C and AIS D refer to motor incomplete injuries with preservation of motor function below the neurological level (Kirshblum et al., 2011).



## **Psychological Adjustment**

Psychological adjustment to SCI varies greatly between individuals in the amount of time it takes individuals to grieve and to accept the reality of their injury and in the unique daily life events they experience during the adjustment process. Those who adjust well are motivated to participate in rehabilitation and lead happy and healthy lives post-injury (University of Alabama at Birmingham Spinal Cord Injury Model System, 2004). Adjustment to disability is a dynamic process consisting of interactions between psychological well-being and physical health (Elliott & Warren, 2007) and can be viewed along both positive and negative dimensions by measuring positive or negative aspects of adjustment to disability (Schmitt & Elliott, 2004). Negative aspects of adjustment include the presence of anxiety or depression following physical disability, whereas positive aspects of adjustment include the constructs of satisfaction with life, personal growth, well-being, and acceptance of disability (Elliott, Kurylo, & Rivera, 2002).

Negative aspects of adjustment, such as anxiety and depression, are not universal nor are they inevitable following SCI; this is the case for individuals with SCI both in initial rehabilitation and residing in the community post-inpatient rehabilitation. However, there is a significant minority of people with SCI who do meet the criteria for anxiety or depression following their SCI. Depressive disorders are the most common form of psychological distress following SCI and occur more frequently in the SCI population than in individuals who do not have disabilities (Elliott & Frank, 1996). During inpatient SCI rehabilitation, about 25% of patients meet the criteria for major

depressive disorder as measured by the PHQ-9 (Bombardier et al., 2012). Also using the PHQ-9, estimates of the prevalence of major depressive disorder range from about 11% or 12% (Arango-Lasprilla et al., 2011; Bombardier et al., 2004) to 21% (Hoffman et al., 2011) 1 year post-injury and from about 10% (Arango-Lasprilla et al., 2011) to 18% (Hoffman et al., 2011) 5 years post-injury. In community-residing individuals with SCI, about 23% meet the criteria for major depressive disorder as measured by the PHQ-9 (Fann et al., 2011). Less research has been conducted on anxiety disorders, but it is estimated that between 13% and 40% of individuals with SCI will develop an anxiety disorder in the first 2 years post-injury (Craig et al., 2009).

Although individuals with SCI who have depression or anxiety constitute a minority of the SCI population, paying attention to these individuals is important. Depression in individuals with SCI is associated with passive or non-compliant behavior (e.g., not cooperating with health providers, refusing to accept medication or treatment, not attending to skin care, misusing medications, mismanaging urinary catheters, not regulating fluid intake) that often results in physical complications (Macleod, 1988). Other problematic behaviors associated with depression in individuals with SCI include fewer hours out of bed, fewer days out of the house, less engagement in productive activities, and less planned exercise (Saunders et al., 2012; Tate et al., 1994). Furthermore, more planned exercise is significantly associated with fewer pressure ulcers over time (Krause & Broderick, 2004). Less is known about the impact of anxiety, but it has been suggested that anxiety may result from the changes associated

with injury and may motivate individuals to engage in health and self-care behaviors (Richards et al., 2010).

Although less is known about anxiety in individuals with SCI, it has been suggested that depression may have a greater influence on SCI outcomes than medical or demographic factors. In a study of individuals with SCI, neither medical nor demographic factors were related to length of stay or to self-care ratings (of bladder program and skin program performance) at discharge. However, patient scores on two different measures of depression contributed significantly to the prediction of length of stay following SCI. Specifically, 40% of the variance in length of stay was accounted for by depression. The measures of depression, along with a measure of psychological distress, also predicted difficulties in learning and performing self-care during inpatient rehabilitation. It was concluded that routine evaluation and monitoring of depression and distress experienced by individuals with SCI is needed because these psychological factors play an important role in the length of hospitalization and may have an adverse effect on learning and performing self-care both for bladder programs and skin care programs (Malec & Neimeyer, 1983).

Concerns have been expressed about the somatic symptoms of depression and how they may interfere with the diagnosis of depression in individuals with SCI, but it is likely that they are not as much of an issue as would be expected. Specifically, research has shown that both somatic symptoms and psychological symptoms of depression are predictive of probable major depressive disorder in individuals with SCI. Thus, somatic

symptoms should be included when diagnosing major depressive disorder in individuals with SCI (Bombardier et al., 2004).

### **Secondary Conditions**

Although a general definition of secondary conditions is still in development, a currently used definition describes secondary conditions as “those physical, medical, cognitive, emotional, or psychosocial consequences to which persons with disabilities are more susceptible by virtue of an underlying condition, including adverse outcomes in health, wellness, participation, and quality of life” (Hough, 1999, p. 186). Secondary conditions develop following trauma or after the onset of disease; SCI is accompanied by more potential secondary conditions than most other diseases or disorders.

Furthermore, because of its chronic nature, individuals with SCI are at risk for secondary conditions throughout their lives, a risk that typically increases over time. It is important to understand the secondary conditions that come with SCI and their risk factors in order to provide treatment interventions and to prevent future occurrence of these secondary conditions (Richards et al., 2004). Secondary complications associated with SCI include pressure ulcers, urinary tract infections, contractures and spasticity, pain, sexuality and reproductive health issues, related head injuries, and obesity (Warren et al., 2013).

**Pressure ulcers.** One of the most common and significant secondary conditions is pressure ulcers (Richards et al., 2004). Pressure ulcers develop when restricted blood flow causes oxygen depletion and tissue damage. For example, the pressure of an individual’s weight pressing up against a wheelchair seat or mattress can result in a pressure ulcer. Pressure ulcer severity is classified according to four stages based on

depth, color, and texture (Burns & Hammond, 2009). Pressure ulcers are considered a preventable secondary condition because it is theorized that they develop when self-care and other preventive health behaviors (e.g., weight shifts, skin checks) are lacking. That is, prevention depends on the individual's ability to be proactive in taking care of his or her skin (Anderson & Andberg, 1979). However, it is important to note that research results conflict as to whether or not there is an association between preventive health behaviors and pressure ulcer occurrence (Krause & Broderick, 2004; Krause, Vines, Farley, Snizek, & Coker, 2001). Specifically, skin monitoring has been found to serve as a protective factor, but research conducted on other preventive health behaviors (e.g., weight redistribution, regular repositioning in bed) has been limited by cross-sectional designs, making it difficult to determine if they also serve as protective factors (Gelis et al., 2009).

Longitudinal research has shown that pressure ulcers are the most frequent secondary condition for individuals with SCI in all follow-up years (McKinley et al., 1999) and that the prevalence of pressure ulcers and the odds of developing pressure ulcers significantly increase with time post-injury (Chen et al., 2005). Although the estimated prevalence and incidence of pressure ulcers in individuals with SCI vary across studies, most research reports that the incidence of pressure ulcers in the first 5 years after injury is at least 30% (Richards et al., 2004). Despite advances in care, pressure ulcer development has remained stable during 20 years of Model Systems data collection (Yarkony & Heinemann, 1995). In a 10-year study with six data collection points, about 50% of individuals with SCI were able to avoid pressure ulcer occurrence

for the entire 10 years, but there was a subgroup of 20% who developed pressure ulcers in the first 6 months post-discharge and then were more likely to have them at multiple follow-ups. This group of patients who experienced recurring pressure ulcers over the 10-year period required extensive medical intervention including hospitalization (Dorsett & Geraghty, 2008).

Not only are pressure ulcers a common secondary condition for individuals with SCI, their impact is great (McKinley et al., 1999), and they have received more attention from health care professionals than any other secondary condition associated with SCI (Byrne & Salzberg, 1996). It is estimated that pressure ulcers are the cause of death for about 8% of individuals with SCI. Even pressure ulcers of a less severe nature impair functional ability and have the potential to prevent individuals with SCI from pursuing educational and vocational goals (McKinley et al., 1999). It is estimated that pressure ulcers account for 25% of the total cost of caring for individuals with SCI, amounting to about \$1.2 billion each year (Byrne & Salzberg, 1996). Although cost estimates for treating pressure ulcers vary, it is clear that the cost of preventing pressure ulcers is far less than the cost of treatment (Richards et al., 2004).

**Veterans with pressure ulcers.** Veterans with SCI who have pressure ulcers use VA health care services more frequently and spend an average of 52 more days in the hospital each year than do veterans with SCI who do not have pressure ulcers. In addition to pressure ulcer status, additional factors that contribute to annual inpatient days are older age, hospitalization in the previous year, and a history of depression. In a year, veterans with SCI who have pressure ulcers see outpatient specialists about 8 more

times and use general outpatient services about 13 more times than do veterans with SCI who do not have pressure ulcers. Total VA health care costs are \$73,021 higher each year for veterans with a pressure ulcer in that year, which amounts to over \$89 million in additional costs for the health care system. The higher cost is primarily due to increased length of inpatient stay, but outpatient costs are also higher for veterans with pressure ulcers than for those without (Stroupe et al., 2011).

Overall, annual treatment costs are over 260% higher for SCI patients who have pressure ulcers. However, this study only examined the presence of pressure ulcers during one year; it is common for pressure ulcers to take more than a year to heal. Thus, the researchers suggested that the cost of treating pressure ulcers may be even higher than what they reported. Due to the high cost, they concluded that interventions that cost \$8,000 or less per patient would ultimately be cost-saving for the VA and would decrease the burden of illness experienced by veterans with pressure ulcers (Stroupe et al., 2011).

**Pressure ulcer risk factors.** In the relevant literature, over 200 risk factors for pressure ulcers have been identified and studied. The risk factors for pressure ulcer development have been classified according to three broad categories: severity of injury (i.e., level of activity, level of mobility), preexisting conditions (i.e., age, cigarette smoking, heart disease, diabetes, psychological issues), and nutritional factors (i.e., malnutrition, anemia; Byrne & Salzberg, 1996). Although a great deal of research has been conducted on pressure ulcer risk factors, much of the research has focused on physiological and mechanical risk factors. Despite focus and efforts in that area, the

frequency and repeated occurrence of pressure ulcers in individuals with SCI suggests that the attention to physiological and mechanical risk factors is insufficient in preventing pressure ulcers. In order to create a program of pressure ulcer prevention, it is first important to differentiate between individuals with recurrent pressure ulcers and individuals who are able to care for their skin (Anderson & Andberg, 1979).

Commonly measured risk factors (e.g., demographics, disease factors) may be helpful in identifying individuals with SCI who are at risk of developing pressure ulcers, but they cannot be modified (Sheppard, Kennedy, & Mackey, 2006). Furthermore, these variables also often do not have much predictive value (Elliott, Bush, & Chen, 2006; Krause et al., 2001; Rodriguez & Garber, 1994). After discharge from a Model Systems program, a variety of demographic (e.g., age, race, education, employment status, gender) and injury-related (e.g., etiology of SCI, level and completeness of injury) variables were evaluated as risk factors, but none predicted pressure ulcer development (Yarkony & Heinemann, 1995). Moreover, in community-residing individuals with SCI, neither demographics nor injury level was associated with the presence of pressure ulcers or the severity of pressure ulcers (Fuhrer, Garber, Rintala, Clearman, & Hart, 1993).

It is important to focus on risk factors that are amenable to treatment, which is one reason why some researchers have begun to explore psychological risk factors for pressure ulcers (Sheppard et al., 2006). It is possible for pressure ulcers to be prevented with the use of proper self-care (i.e., pressure relief and skin checking); thus, it is important to attend to prevention strategies and the modifiable psychological factors that



may be associated with them (Krause, 1998). Research has shown no relation between health beliefs and pressure ulcer occurrence, suggesting that attitudes about skin-care are insufficient in explaining adherence to skin-care routines (Rodriguez & Garber, 1994). Thus, although knowledge and attitudes may play a role in pressure ulcer development, they do not distinguish between individuals who do and do not develop pressure sores, meaning that other psychological factors may be more influential (Sheppard et al., 2006).

A longitudinal study of pressure ulcer occurrence in men with SCI, which was conducted in response to criticisms of cross-sectional designs, showed that the strongest predictor of self-reported pressure ulcer development during the 3-year study period was pressure ulcer occurrence in the year prior to the start of the study. Although the researchers did not include psychological variables as potential predictors of pressure ulcer occurrence, they described in their conclusion a clinic affiliated with their institution that operated from 1977 to 1982 with the goal of preventing pressure ulcers. Through education, they were able to reduce pressure ulcer recurrence from 32% to 11% and then from 11% to 4% with the addition of “intensive psychological counseling” (Garber, Rintala, Hart, & Fuhrer, 2000). This suggests that psychological factors also play a role in pressure ulcer development and recurrence despite being excluded from most studies of pressure ulcer risk factors.

***Psychological risk factors.*** The earliest research on psychological risk factors for pressure ulcer development and recurrence was conducted in the late 1970s (Anderson & Andberg, 1979). The rationale was that maintaining skin integrity pertains

less to mechanical aids and more-so to patient attitudes. Thus, their purpose was to explore the impact of three psychological factors (e.g., feelings about and practice of responsibility in skin care, satisfaction with life activities, self-esteem) on the incidence and impact of pressure ulcers in individuals with SCI who had been injured for at least 1 year. Anderson and Andberg divided the sample of 141 participants into two groups: those with no time lost due to pressure ulcers in the previous 2 years and those who did lose time in the previous 2 years due to pressure ulcers. Those who had lost no time scored higher on the responsibility and satisfaction variables than did individuals who did lose time; self-esteem was not statistically significantly different between the two groups. Moreover, there was no statistically significant difference in group membership between individuals with paraplegia and those with tetraplegia (Anderson & Andberg, 1979).

Additional analyses revealed that 26% of recent pressure ulcer history could be predicted by participant scores on the three psychological variables (e.g., responsibility, satisfaction, self-esteem); the satisfaction variable explained the greatest amount of variance in recent pressure ulcer history. The research conducted by Anderson and Andberg demonstrated patterns of pressure ulcer incidence that were directly related to psychological factors, but not directly related to mechanical factors. Contributing to the lack of support for a mechanical explanation of pressure ulcer occurrence was the fact that the individuals with paraplegia in the study had more extensive pressure ulcer histories than did the individuals with tetraplegia. Anderson and Andberg concluded that the ability to maintain skin integrity is not related to level of injury, but is related to

the psychological variables of responsibility and satisfaction (Anderson & Andberg, 1979).

In the 35 plus years since Anderson and Andberg's (1979) research, additional research on psychological risk factors for pressure ulcers in individuals with SCI has followed. A sample of 53 veterans with SCI ranging from 1 month post-injury to over 40 years post-injury was divided into two groups: those with occurrence of pressure ulcers and those with nonoccurrence of pressure ulcers 1 year after an initial interview. The group with nonoccurrence of pressure ulcers 1 year after the initial interview was characterized by effective problem-solving skills after taking into account other characteristics; demographic variables were not found to predict pressure ulcer incidence. More recent injuries were associated with pressure ulcer occurrence, as was tetraplegia (Herrick, Elliott, & Crow, 1994a), which conflicts with the findings of Anderson and Andberg (1979) that individuals with paraplegia may be more at risk for developing pressure ulcers. Herrick and colleagues concluded that models based on behavioral mechanisms in the development of pressure ulcers are more likely to lead to convergence in the literature (Herrick, Elliott, & Crow, 1994a).

Elliott and colleagues (2006) conducted a study of 188 individuals all within 1 year of SCI and used structural equation modeling to investigate hypothesized relationships. Results of a path analysis revealed that demographic characteristics significantly influenced both problem-solving abilities and injury severity, but did not directly predict pressure ulcer occurrence. However, demographic characteristics were significantly associated with pressure ulcer occurrence through a direct path from the

mediating construct of problem-solving abilities to pressure ulcer occurrence. Additionally, injury severity was significantly associated with problem-solving abilities, but not with pressure ulcer occurrence. Across the 3-year duration of the study, ineffective problem-solving abilities were associated with a higher rate of pressure ulcer occurrence. Elliott and colleagues concluded that cognitive-behavioral characteristics are predictive of pressure ulcer occurrence in the first 3 years following SCI. Although research in this field typically has not focused on psychological predictors of pressure ulcers, they asserted that the demographic and condition-specific variables that are typically studied are not only unmodifiable, but also may have less predictive value when cognitive-behavioral characteristics are considered (Elliott et al., 2006).

***Depression and anxiety.*** Most of the research conducted on psychological predictors of pressure ulcers has focused on depression in particular. Little research has examined anxiety as a predictor of pressure ulcer occurrence, but it was included alongside depression in a cross-sectional study of individuals with SCI whose time since injury ranged from 1 year to 10 years. Results revealed that increased anxiety was associated with less likelihood of developing pressure ulcers, whereas increased depression was associated with increased likelihood of developing pressure ulcers (Sheppard et al., 2006). Despite the inclusion of anxiety in that study, most research has focused on depression as a risk factor for pressure ulcer occurrence.

For example, a sample of 52 individuals with SCI, ranging from less than 1 year to over 40 years post-injury, was divided into three groups: neither pressure ulcers nor urinary tract infections, either of the complications, or both of the complications in the

year following an initial interview. The individuals with membership in either of the secondary complication groups had higher levels of depression, higher reassurance of worth social support, lower opportunities for nurturance social support, and higher attachment support. Moreover, the psychological variables accounted for 36% of the variance in the groupings. Herrick and colleagues acknowledged that it is possible that the depressive symptoms experienced by the individuals with SCI in this study may have resulted from the secondary conditions, but they asserted that the significant associations between depression and secondary conditions indicate that depression can, potentially, serve as a way of distinguishing between those individuals with SCI who are hospitalized for secondary complications and those who are admitted for routine check-ups (Herrick, Elliott, & Crow, 1994b).

Later research consisted of a sample of 186 individuals with SCI admitted for rehabilitation within 1 year of injury; however, in this study, depression was not predictive of pressure ulcer diagnosis at the annual evaluation (Elliott, 1999). Elliott (1999) concluded that the reason for the difference in results is that the earlier study (Herrick, Elliott, & Crow, 1994b) consisted of a sample of individuals who had been injured for several months to many years; it is possible that in the first year post-injury, it is more difficult to detect risk factors because pressure ulcer patterns have not yet developed and because the impact of factors such as depression may not be immediate.

In order to account for this issue, research has been conducted with samples that are more than 1 year post-injury. In a cross-sectional study with a sample of 560 individuals who were all at least 1 year post-injury, suicidal ideation and suicide

attempts were measured as a means of examining severe depression as a potential risk factor for pressure ulcers. Although suicidal behaviors were not significantly associated with increased risk of having a current pressure ulcer or having had a pressure ulcer in the previous year, they were significantly associated with greater risk of being hospitalized for a pressure ulcer following SCI. Moreover, of the three different outcomes studied, hospitalization for a pressure ulcer was the outcome most strongly associated with the risk factors studied (e.g., suicidal ideation, suicidal attempts, having been incarcerated; Krause et al., 2001).

In a cross-sectional study with a sample of veterans who were at least 20 years post-injury, veterans with frequent depressive symptoms (i.e., 14 or more days of depressive symptoms in the past month) were 30% more likely to report having had a pressure ulcer; demographics and injury level were not associated with pressure ulcer occurrence (Smith, Guihan, LaVela, & Garber, 2008). Research has also been conducted with a sample consisting only of individuals who were at least 5 years post-injury and the results revealed that depressive symptoms were a significant risk factor for recurrent pressure ulcers. However, there was no statistically significant relation between specific pressure ulcer prevention behaviors (e.g., performing weight shifts, checking skin, turning in bed) and pressure ulcer history. Thus, focusing solely on teaching preventive behaviors may not be effective in reducing pressure ulcer recurrence; it is necessary to attend to affective states that may precede preventive health behaviors. However, this study was limited in that patients were not followed over time to determine pressure ulcer recurrence; they were asked to self-report their pressure ulcer

history. The researchers recommended that pressure ulcer history be studied over time with a longitudinal design (Krause & Broderick, 2004).

Based on this recommendation, a 17-year study of 466 individuals with pediatric-onset SCI was conducted. Anxiety and depression were common in the sample (29.2% and 21.7%, respectively). Results showed that both individuals with depression and individuals with anxiety were at greater risk for the secondary complication of pain, but only individuals with depression were at greater risk for developing pressure ulcers. Individuals with anxiety were more integrated and participatory in the community in several areas than were individuals with depression (e.g., economic self-sufficiency, physical independence, occupation, social integration). The researchers posited that depressive symptoms may have adverse effects on medical compliance and self-care, thus increasing vulnerability to developing secondary conditions (January et al., 2014).

***Behavioral mechanisms.*** Behavioral medicine research has indicated that if an individual has psychological issues, his or her adherence to health behavior recommendations has the potential to be compromised. That is, although psychological risk factors are often overlooked, they need to be assessed and treated as part of the effort to prevent pressure ulcers and their recurrence. Specifically, psychological distress interferes with cooperation and is associated with inactivity, self-neglect, and poor medical adherence (Consortium for Spinal Cord Medicine, 2000).

A conceptual model has been created in order to help researchers explore the relation between depressive symptoms and secondary conditions, such as pressure ulcers (Krueger, Noonan, Williams, Trenaman, & Rivers, 2013). Similar models have been

developed for other conditions (e.g., diabetes), prompting Krueger and colleagues to create a model specific to SCI based on other models in the field of chronic disease management and on the International Classification of Functioning, Disability, and Health (ICF; World Health Organization, 2002). The ICF incorporates three levels of functioning (i.e., the body or a body part, the person as a whole, the individual in a particular social context) as means of classifying the changes in functioning that result from health conditions. The three levels are called Body Structures/Functions, Activities, and Participation. Environmental factors and personal factors are also considered within the ICF, but the SCI-specific model focuses primarily on the personal factors because of the emphasis on patient-driven mechanisms. However, one can still clearly identify all of the ICF elements within the SCI-specific conceptual model (Krueger et al., 2013).

Specifically, in the conceptual model, depression causes elevated occurrence of physical complications in individuals with SCI through the ultimate mechanism of poor adherence to self-management behaviors, which corresponds with the ICF category of Activities. Additionally, the intermediate mechanisms that precede the ultimate mechanism also match with ICF components. For example, compromised beliefs and knowledge regarding self-management corresponds with Personal Factors, potential physical capacity not realized corresponds with Body Structures, potential functional capability not achieved corresponds with Body Functions, and limited use of assistive resources corresponds with Participation. The proximate mechanisms, which are closest to the experience of depression and farthest from the final effect of increased secondary



conditions, are based on other frameworks within chronic disease care. The proximate mechanisms are non-adherence to self-management training, non-adherence to other rehabilitation, and substance abuse. It is also important to note that the conceptual model includes a feedback loop due to the possibility that depression and its effects are likely to become progressively worse (Krueger et al., 2013).

Although research on the relation between depression following SCI and elevated rates of secondary conditions is limited, the research that has been conducted provides evidence in support of this conceptual model. In looking at the model from a global perspective, they cited the study conducted by Herrick and colleagues (1994b) showing that depression was predictive of pressure ulcers 1 year following assessment. In looking at specific mechanisms within the overall model, they cited studies showing that depression produces poor self-care skills and poor functional capability (Elliott & Frank, 1996; Fann et al., 2011), and that daily skin monitoring is a significant protective factor in the development of pressure ulcers (Gelis et al., 2009). The researchers concluded that additional research should be conducted in order to test, refine, and apply the model. They suggested that future research take a global approach (i.e., evidence for depression causing an increase in secondary conditions through the use of longitudinal data) or focus on specific component mechanisms within the overall model. Overall, they stated that future research should be conducted within a framework that focuses on treating depression as a means of improving health care for individuals with SCI (Krueger et al., 2013).

## **Methodological Issues**

As noted earlier, most research on predictors of secondary conditions, including pressure ulcers, has focused on risk factors that are objective and easily measured, such as demographic characteristics. It has been suggested that these “risk factors” may be very much removed from the actual risk factors that lead to secondary conditions and may actually serve as “marker variables.” If research can be conducted using variables that may be more closely associated with the development of secondary conditions, the outcome would be risk models that can better inform treatment and prevention (Richards et al., 2004).

Additionally, much of the research conducted on risk factors for pressure ulcer development is limited by small sample size and inadequate follow-up (Byrne & Salzberg, 1996). It is possible that the conflicting results in the literature as to what predicts pressure ulcers in individuals with SCI are a product of cross-sectional designs that are focused on individuals who have been injured for less than 2 years (Garber et al., 2000). Most of the research conducted on secondary complications of SCI has been cross-sectional in nature and the results of the cross-sectional studies often conflict with the results from the few longitudinal studies that have been conducted (Coll, 2007). It has been asserted that cross-sectional designs cannot account for how mental health issues may relate to secondary conditions over time (January et al., 2014).

For these reasons, research has been conducted to determine whether longitudinal changes in secondary complications can be represented adequately by cross-sectional analyses. A variety of secondary complications were considered and for most of them,

the cross-sectional effects were not significant, but the longitudinal effects were associated with increasing risk over time, regardless of age or years post-injury. It was concluded that longitudinal research is needed in order to detect the effects of risk factors for secondary complications over time (Coll, 2007). Research has shown that depression contributes significantly to the variance in pressure ulcer severity and that the longer the time since injury onset, the greater the influence of depression on pressure ulcer severity. These researchers recommended that a longitudinal design be used to examine the impact of depression over the course of SCI to see how these two conditions (i.e., depression and time post-injury) combine to heighten the risk of severe pressure ulcers (Martz, Livneh, Gontkovsky, & Stokic, 2010).

In line with the recommendation for additional longitudinal research, it was important for the purposes of the present study to select statistical analyses appropriate for the longitudinal data collected, specifically survival analysis techniques. Survival analysis is applicable when a sample of patients is followed from a well-defined starting point to the occurrence of a well-defined outcome (Fleiss, Dunner, Stallone, & Fieve, 1976), such as pressure ulcer occurrence. In survival analysis, the dependent variable is the length of time to an event, such as death, which is why the statistical techniques are known as survival analysis. Survival analysis is able to reveal which type of patient is more likely to experience the event sooner than other types of patients. Simple designs require only survival time and censoring status; the time-to-event variable can be measured in any practical unit of time. For participants who do not experience the event during the study or drop out of the study before it is completed, their event status is

censored (Luke & Homan, 1998). It is essential to note that when no censored cases are present, linear regression can be perfectly appropriate. However, it is uncommon for this to be the case, especially in the context of the present study because not all participants developed a pressure ulcer during the duration of the study. Thus, use of survival analysis instead of other statistical methods is most important when participants are lost to follow-up or do not experience the event of interest during the study period (Bewick, Cheek, & Ball, 2004; Young, Menegazzi, & Lewis, 1999).

Survival analysis has been used as the statistical method of choice in several studies concerned with pressure ulcer occurrence in individuals with SCI (Guihan, et al., 2008; Pickelsimer, Shiroma, & Wilson, 2010; Rintala, Garber, Friedman, & Holmes, 2008). One study examined factors associated with recurrence of severe pressure ulcers (i.e., stage 3 or stage 4) after having had a previous severe pressure ulcer heal completely. Time-to-event was calculated as the time from discharge to skin breakdown and demographic and injury characteristics were considered as potential predictors. The only factor found to be predictive of faster recurrence was African-American race; this was attributed to the ineffective nature of visual inspection techniques in identifying skin breakdown in individuals with darkly pigmented skin (Guihan et al., 2008).

A second study investigated the impact of an educational intervention for preventing recurrence of pressure ulcers after surgical repair of a severe pressure ulcer. Results showed that participants who received the enhanced educational and structured follow-up intervention were ulcer-free longer than participants who did not receive the intervention. Other factors (e.g., self-assessed health status, injury level, type of

surgery) were not predictive of ulcer-free survival time (Rintala et al., 2008). An additional study considered pressure ulcers along with several other secondary conditions that may occur in the first 10 years after SCI. A life table showed that the highest incidence of secondary conditions was in the first 5 years after injury; gender was examined as a potential explanatory factor, but was not found to be statistically significant (Pickelsimer, Shiroma, & Wilson, 2010).

Although none of these studies included depression or anxiety as potential explanatory factors, it has been suggested that survival analysis is well-suited for studying psychologically important changes (e.g., becoming pregnant, attempting suicide, becoming infected with HIV; Luke & Homan, 1998). One specific survival analysis technique is the life table, which is used to estimate the probability that a patient will experience the outcome under study within discrete time intervals (Fleiss et al., 1976). The life table is particularly relevant to the present study because it allows for time to be measured in discrete intervals, as was done when creating the year-long time intervals used in the present study.

The life table is also useful in that it provides the median survival time, which is more useful than the mean survival time because of the skewed distribution of survival time and the presence of censored cases. Additionally, graphical representation of survival function from the life table procedure, which shows time on the horizontal axis and proportion of cases still surviving on the vertical axis, is helpful in interpreting survival probability and rate of failure. It is common to include covariates to investigate how other variables may influence survival times; these covariates can be categorical or

continuous. In the life table procedure, one categorical factor can be considered; with the Cox regression procedure, multiple categorical or continuous factors can be considered (Luke & Homan, 1998). Again, standard multivariate regression methods cannot be used with survival data because of the skewing of the data and the presence of censored cases. However, Cox regression is analogous to a multiple regression model (Bewick, Cheek, & Ball, 2004) and can be utilized to determine the independent risk contributed by each explanatory variable (Young, Menegazzi, & Lewis, 1999).

## CHAPTER III

### METHODS

#### **Participants**

A total of 117 veterans (5 women, 112 men) were admitted consecutively to the SCI Center at the MEDVAMC in Houston, Texas for initial inpatient SCI rehabilitation from 2008 to 2011. Participants ranged in age from 18 years to 84 years ( $M = 55.86$ ;  $SD = 13.52$ ) at the time of injury. Most participants were White (61.5%); 31.6% identified as African-American and 6.8% identified as Hispanic. Years of education at the time of injury ranged from 7 to 18 ( $M = 12.76$ ;  $SD = 2.05$ ). Most participants had not experienced loss of consciousness (LOC) at the time of injury (80%). Tetraplegia was more prevalent (66.7%) than paraplegia (33.3%). In terms of injury completeness, 18.8% of injuries were classified as AIS A, 11.6% as AIS B, 27.7% as AIS C, and 42% as AIS D. Most injuries were the result of trauma (57.3%); 38.5% of injuries were non-traumatic and 4.3% were the result of other causes. Of note, no injuries occurred during combat or as the result of combat. Time between the date of injury and admission to initial inpatient rehabilitation ranged from 0 days to 227 days ( $M = 43.26$ ;  $SD = 48.67$ ). Length of stay ranged from 15 days to 357 days ( $M = 93.38$ ;  $SD = 54.16$ ).

During initial inpatient rehabilitation, 47.9% of participants had a pressure ulcer. In the first 3 years following discharge, declining rates of pressure ulcer occurrence were observed. Specifically, 39.6% had a pressure ulcer in the first year, 32.7% had a pressure ulcer in the second year, and 28.3% had a pressure ulcer in the third year. For

those participants who had a pressure ulcer during rehabilitation, stage 2 pressure ulcers were most common. However, stage 4 pressure ulcers were most common among participants with pressure ulcers in the first 3 years post-discharge.

Of these 117 individuals, 82 veterans had completed the routine psychological assessments at admission and discharge. Common reasons why 35 veterans did not complete the brief measures at one or both of the two time points include refusal at either admission or discharge or both, poor physical health at admission, or discharge at a time when a psychologist was unavailable (e.g., during the weekend). In order to assess the potential role of mental health in predicting time to pressure ulcer occurrence and time to severe pressure ulcer occurrence during initial inpatient rehabilitation and in the first 3 years following discharge, criteria for inclusion in the present study included completion of the routine psychological assessment at both admission and discharge. Thus, the 82 veterans who had psychological data at both admission and discharge were included for participation and statistical analysis.

Within the sample of 82 veterans (5 women, 77 men), demographic and injury characteristics were very similar to the overall sample of 117 veterans. Specifically, participants ranged in age from 18 years to 84 years ( $M = 54.59$ ;  $SD = 14.35$ ) at the time of injury. Most participants were White (62.2%); 30.5% identified as African-American and 7.3% identified as Hispanic. Years of education at the time of injury ranged from 7 to 18 ( $M = 12.74$ ;  $SD = 2.07$ ). Most participants had not experienced loss of consciousness (LOC) at the time of injury (74.4%). Tetraplegia was more prevalent (62.2%) than paraplegia (37.8%). In terms of injury completeness, 22.1% of injuries



were classified as AIS A, 11.7% as AIS B, 22.1% as AIS C, and 44.2% as AIS D. Most injuries were the result of trauma (54.9%); 40.2% of injuries were non-traumatic and 4.9% were the result of other causes. Time between the date of injury and admission to initial inpatient rehabilitation ranged from 0 days to 215 days ( $M = 43.41$ ;  $SD = 54.27$ ). Length of stay ranged from 21 days to 232 days ( $M = 90.56$ ;  $SD = 49.28$ ).

During initial inpatient rehabilitation, 51.2% of participants had a pressure ulcer. In the first 3 years following discharge, declining rates of pressure ulcer occurrence were observed. Specifically, 41.6% had a pressure ulcer in the first year, 36.6% had a pressure ulcer in the second year, and 32.8% had a pressure ulcer in the third year. For those participants who had a pressure ulcer during rehabilitation, stage 2 pressure ulcers were most common. However, stage 4 pressure ulcers were most common amongst participants with pressure ulcers in the first 3 years post-discharge.

In comparing the full sample of 117 veterans with the 82 veterans who completed the psychological assessment at both admission and discharge, it is important to note similarities and differences. Average age was comparable, as was racial/ethnic breakdown and years of education. In terms of injury characteristics, the majority of veterans in both samples did not experience LOC at the time of injury, though the lack of LOC was slightly more common in the full sample of 117 veterans. Tetraplegia was also slightly more prevalent in the full sample of 117 veterans. Although AIS D was the most common classification for both samples, AIS C followed in the sample of 117 veterans, whereas equal rates of AIS A and AIS C were seen in the sample of 82 veterans. Trauma was the most common cause of injury in both samples. Time since

injury was comparable, as was length of stay. In both samples, about half of the veterans had a pressure ulcer during initial inpatient rehabilitation. Additionally, declining rates of pressure ulcer occurrence were seen in both samples in the first 3 years following discharge. Moreover, for both samples, stage 2 pressure ulcers were most common among veterans who had a pressure ulcer during rehabilitation, and stage 4 pressure ulcers were most common among participants with pressure ulcers in the first 3 years post-discharge.

Additional chart review was conducted to determine how many of the 42 participants who had a pressure ulcer during initial inpatient rehabilitation were admitted with a pre-existing pressure ulcer as well as the severity of the pressure ulcer and the highest staged pressure ulcer during initial inpatient rehabilitation. The chart review was conducted by two independent raters and resulted in 80.95% agreement on presence or absence of pressure ulcer and its severity at admission and 85.71% agreement on highest stage of pressure ulcer during initial inpatient rehabilitation. In cases where the two independent raters did not agree, the participant's skin status was designated as "undetermined," which was most often due to separate assessments conducted by different disciplines (i.e., nursing and medical) with inconsistent or conflicting documentation in the medical record regarding presence of a pressure ulcer and/or the stage of the pressure ulcer.

For the 34 participants with consistent pressure ulcer information at admission to initial inpatient rehabilitation, 26.47% were admitted with intact skin, 8.82% were admitted with a stage 1 pressure ulcer, 41.18% were admitted with a stage 2 pressure

ulcer, 14.71% were admitted with a stage 3 pressure ulcer, and 8.82% were admitted with a stage 4 pressure ulcer. For the 36 participants with consistent information regarding highest stage of pressure ulcer during initial inpatient rehabilitation, stage 1 was the highest stage for 5.56% of participants, stage 2 was the highest stage for 50% of participants, stage 3 was the highest stage for 19.44% of participants, and stage 4 was the highest stage for 25% of participants. For the 32 participants with consistent pressure ulcer information both at admission and regarding highest stage during initial inpatient rehabilitation, 25% were admitted with intact skin and developed a mild pressure ulcer (i.e., stage 1 or stage 2) during initial inpatient rehabilitation, no participants were admitted with intact skin and developed a severe pressure ulcer (i.e., stage 3 or stage 4) during initial inpatient rehabilitation, 31.25% were admitted with a mild pressure ulcer and did not experience a severe pressure ulcer during initial inpatient rehabilitation, 18.75% were admitted with a mild pressure ulcer and did experience a severe pressure ulcer during initial inpatient rehabilitation, and 25% were admitted with a severe pressure ulcer. It is important to note, however, that for participants who were admitted with a pre-existing pressure ulcer and did or did not experience a higher staged pressure ulcer during initial inpatient rehabilitation, this may indicate the continued presence of the same pressure ulcer or the development of a new pressure ulcer.

## **Procedures**

A retrospective review of medical records was conducted to obtain data for veterans who were admitted consecutively for initial inpatient SCI rehabilitation beginning in the year 2008. As of January 1, 2008, brief measures were given as part of

a routine psychological assessment completed by patients at admission and discharge. All notes were reviewed for each patient during initial inpatient rehabilitation and for the first 3 years post-discharge. Information pertaining to pressure ulcer occurrence and severity were gathered from notes written by attending physicians, resident physicians, and registered nurses. It is important to note that the word “occurrence” is utilized in the present study to describe the presence of a pressure ulcer during a specific time interval and does not necessarily imply that the pressure ulcer developed during that specific time interval. It may indicate continued presence of a previously developed pressure ulcer or development of a new pressure ulcer. Assessment notes written by psychologists, psychology pre-doctoral interns, and psychology externs were reviewed to obtain information pertaining to symptoms of depression and anxiety. Prior to data collection, the present study was approved by the institutional review boards at Texas A&M University and Baylor College of Medicine, as well as by the Research and Development Committee at the MEDVAMC.

Predictor variables included demographic characteristics (age, race, gender, education), injury severity (injury level, injury completeness, loss of consciousness at the time of injury), depression, and anxiety; outcome variables were time to pressure ulcer occurrence and time to severe pressure ulcer occurrence. Depression was measured by the PHQ-9 and anxiety was assessed with the PC-PTSD, as detailed below. Pressure ulcer occurrence was defined as the presence or absence of pressure ulcers (0 = absent, 1 = present), and pressure ulcer severity was defined as mild or severe (0 = stages 1 and 2, 1 = stages 3 and 4). Time to pressure ulcer occurrence and time to severe

pressure ulcer occurrence were classified according to the four discrete time intervals utilized in the present study (0 = initial inpatient rehabilitation, 1 = first year post-discharge, 2 = second year post-discharge, 3 = third year post-discharge).

## **Measures**

**Patient Health Questionnaire-9 (PHQ-9).** The PHQ-9 is the nine item depression module from the full PHQ (Spitzer, Kroenke, & Williams, 1999). It consists of the nine criteria upon which diagnoses of DSM-IV depressive disorders are based. The PHQ-9 allows clinicians to diagnose depressive disorders as well as determine depressive symptom severity. To make a diagnosis, five or more of the nine criteria must be endorsed for at least “more than half the days” and one of the symptoms must be depressed mood or anhedonia. In terms of determining depressive symptom severity, scores on the PHQ-9 range from 0 to 27; scores of 5, 10, 15, and 20 serve as cutoffs that indicate mild, moderate, moderately severe, and severe depression. The internal consistency of the data was excellent in both a primary care sample of 3,000 ( $\alpha = .89$ ) and in an ob-gyn sample of 3,000 ( $\alpha = .86$ ). The test-retest reliability was .84 for a period of 48 hours, and it was demonstrated that the PHQ-9 discriminates well between individuals with and without depression (AUC = .95). Furthermore, the PHQ-9 correlated well (.73) with the mental health scale of the SF-20 (Stewart, Hays, & Ware, 1988). It was concluded that scoring the PHQ-9 as a continuous measure and using a cutoff score of 10 or higher results in the most accurate predictions of major depressive disorder when compared with independent diagnoses made by a mental health provider (Kroenke, Spitzer, & Williams, 2001).

The PHQ-9 was developed, tested, and refined for use with medical patients; for this reason, its clinical utility has been evaluated for individuals with SCI. A sample of 849 individuals with SCI who were all 1 year post-injury completed the PHQ-9 in addition to several other measures. The internal consistency of the data was excellent ( $\alpha = .87$ ) and the researchers found moderately strong correlations between the PHQ-9 and measures of conceptually-related variables, such as satisfaction with life, subjective health, and difficulty performing daily activities. It was concluded that the PHQ-9 can serve as a useful screen for probable major depressive disorder in individuals with SCI. Additionally, all symptoms were efficient predictors of probable major depressive disorder, providing support for the inclusive approach to diagnosing major depressive disorder in individuals with SCI, which means that all symptoms are considered regardless of their etiology (e.g., direct physiological consequence of a general medical condition). That is, both somatic symptoms and non-somatic symptoms of depression are predictive of probable major depressive disorder in individuals with SCI. Thus, somatic symptoms should be included when diagnosing major depressive disorder in individuals with SCI (Bombardier et al., 2004).

The PHQ-9 was used in the present study both as a total score ranging from 0 to 27 and as a dichotomous measure of whether participants were depressed or not depressed based on the recommended cutoff score of 10 or higher in predicting depression. That is, for analyses requiring a continuous variable, the total score was used, and for analyses requiring a categorical variable, the dichotomous score (0 = not depressed, 1 = depressed) was used.

**Primary Care PTSD Screen (PC-PTSD).** The PC-PTSD is a 4-item screen developed for use in primary care and medical settings. The screen is considered “positive” if a patient answers “yes” to any three of the four items, which pertain to re-experiencing, numbing, avoidance, and hyperarousal. A sample of 188 VA primary care patients completed the PC-PTSD along with the Clinician-Administered PTSD Scale (CAPS; Blake et al., 1995) and the PTSD Checklist (PCL; Blanchard, Jones-Alexander, Buckley, & Forneris, 1996) and then the PC-PTSD again 1 month later. Test-retest reliability for the PC-PTSD was good ( $r = .83$ ) and the correlation between the PC-PTSD and the CAPS was  $r = .83$ . Although the PCL outperformed the PC-PTSD, it was suggested that it may be too lengthy for use in medical settings. Thus, it was concluded that the PC-PTSD is a psychometrically sound screen for identifying VA primary care patients with and without PTSD (Prins et al., 2003).

The inclusion of avoidance in the PC-PTSD is of interest because this factor is not included in many other brief measures of anxiety, such as the Generalized Anxiety Disorder 7-item Scale (GAD-7; Spitzer, Kroenke, Williams, & Lowe, 2006). The examination of avoidance is important because of its potential relevance to the ultimate mechanism of poor adherence to health and self-care behaviors that results in the increased occurrence of secondary conditions, as modeled by Krueger and colleagues (Krueger et al., 2013). Moreover, due to a strong correlation between the GAD-7 and the PHQ-9 ( $r = .74$ ; Ryan, Bailey, Fearon, & King, 2013), the PC-PTSD was used as the measure of anxiety for the present study.

As was done with the PHQ-9, the PC-PTSD was used in the present study both as a total score ranging from 0 to 4 and as a dichotomous measure of whether participants screened positive or negative for PTSD based on the endorsement of at least three items necessary for a positive screen. That is, for analyses requiring a continuous variable, the total score was used, and for analyses requiring a categorical variable, the dichotomous score (0 = negative screen, 1 = positive screen) was used. The item pertaining to avoidance was used as a dichotomous variable (0 = negative endorsement, 1 = positive endorsement) only.

### **Statistical Analysis**

All statistical analyses were conducted using the IBM SPSS Statistics software package. In order to assess the potential role of psychological variables in predicting time to pressure ulcer occurrence and time to severe pressure ulcer occurrence during initial inpatient rehabilitation and in the first 3 years following discharge, criteria for inclusion in the present study included completion of the routine psychological assessment at both admission and discharge. The full sample with missing data was compared with the sample of participants without missing data to explore any potential differences between participants with and without missing data. Relations among psychological variables and pressure ulcer occurrence and severity were examined with chi-square tests for association and crosstabulation tables.

Survival analysis was used to measure the time from SCI onset to pressure ulcer occurrence and from SCI onset to severe pressure ulcer occurrence (i.e., stage 3 or stage 4), as well as the explanatory role of depression and anxiety in predicting survival time.



Survival analysis measures the time from a starting point to the occurrence of an event, such as the time from diagnosis of a disease to death. The reason why survival analysis is more fitting than standard statistical techniques is that the distribution is hardly ever normal and the data are frequently censored; the data are censored when the event does not occur during the follow-up time (Bewick, Cheek, & Ball, 2004).

In terms of interpreting survival analysis results, the hazard rate and the hazard ratio are particularly useful. When examining the results of a life table analysis, the hazard rate is an estimate of the risk of experiencing the terminal event during the interval, conditional upon surviving to the start of the interval. Regarding Cox regression results, the hazard ratio, when positive, indicates that every unit increase in the covariate value increases the mean number of pressure ulcers and decreases the mean elapsed time to the occurrence of a pressure ulcer. In other words, it is the predicted change in the hazard rate for a unit increase in the predictor. For example, a hazard ratio of 1.098 indicates that every unit increase in the covariate produces a 9.8% increase in the mean rate of event occurrence and approximately a 9.8% decrease in the mean elapsed time to event occurrence. A two unit increase in the covariate produces an increase of  $(1.098)^2$  or about 20.6% and a five unit increase in the covariate produces an increase of  $(1.098)^5$  or about 60%.

**Hypotheses and corresponding analyses.** It was hypothesized that depression would be predictive of shorter ulcer-free survival times as well as shorter severe ulcer-free survival times. Depression at both admission to and discharge from initial inpatient rehabilitation were considered as predictors; life tables were used to study the

dichotomous variable of depression status, whereas Cox regression was utilized to examine the continuous variable of total depression score.

It was hypothesized that anxiety would be predictive of longer ulcer-free survival times as well as longer severe ulcer-free survival times. However, it was also hypothesized that the specific symptom of avoidance would be predictive of shorter ulcer-free survival times as well as shorter severe ulcer-free survival times. Life tables were used to study the dichotomous variables of PTSD screen status and avoidance endorsement, whereas Cox regression was utilized to examine the continuous variable of total PTSD score.

## CHAPTER IV

### RESULTS

#### **Psychological Assessment Information**

All 82 participants completed the PHQ-9 at both admission to and discharge from initial inpatient rehabilitation. Admission depression scores ranged from 0 to 25 ( $M = 8.32$ ;  $SD = 6.58$ ), and discharge depression scores ranged from 0 to 22 ( $M = 4.23$ ;  $SD = 4.65$ ). Using the recommended cutoff score of 10 (Kroenke et al., 2001), 40.2% of participants met the cutoff at admission, whereas only 13.4% met the cutoff at discharge (see Figure 1). There was a statistically significant improvement in depression scores from admission to discharge,  $t(81) = 5.858$ ,  $p < .0001$ . Of note, there was not a strong correlation between length of stay during initial inpatient rehabilitation and decrease in depression score from admission to discharge.

Participants were placed into one of four categories based on whether they were above or below the cutoff for depression at admission and above or below the cutoff for depression at discharge (i.e., below and below, above and below, below and above, above and above) to determine if membership in these categories was associated with any demographic or injury characteristics. The only association was with injury level. That is,  $\chi^2$  analyses revealed a statistically significant association between change in depression status from admission to discharge and injury level,  $\chi^2(3, n = 82) = 7.897$ ,  $p = .048$ , Cramer's  $V = .31$ . Specifically, a greater proportion of participants who were below the cutoff for depression at both admission and discharge were those with

tetraplegia (67.4%) compared with paraplegia (32.6%). Conversely, a greater proportion of participants who were above the cutoff for depression at both admission and discharge were those with paraplegia (62.5%) compared with tetraplegia (37.5%).

Research has shown that during inpatient rehabilitation for SCI, there are two factors underlying the PHQ-9, one of which is somatic (Krause, Bombardier, & Carter, 2008). The other factor has been called general (Krause et al., 2008), cognitive/affective (Kalpakjian et al., 2009), and non-somatic (Bombardier et al., 2012; Bombardier & Smiley, 2015; Krause, Reed, & McArdle, 2010). For the purposes of the present study, the term non-somatic is used to refer to this factor. Somatic items (i.e., sleep disturbance, poor energy, appetite change) and non-somatic items within the PHQ-9 were scaled to range from 0 to 27 for purposes of comparison. At admission, somatic depression ranged from 0 to 27 ( $M = 11.45$ ;  $SD = 8.41$ ), whereas at discharge, somatic depression ranged from 0 to 24 ( $M = 6.44$ ;  $SD = 6.69$ ). Accordingly, at admission, non-somatic depression ranged from 0 to 24 ( $M = 6.75$ ;  $SD = 6.97$ ), whereas at discharge, non-somatic depression ranged from 0 to 21 ( $M = 3.22$ ;  $SD = 4.45$ ). That is, statistically significant improvements were seen both in somatic symptoms,  $t(81) = 5.276$ ,  $p < .0001$ , and in non-somatic symptoms,  $t(81) = 4.903$ ,  $p < .0001$ , from admission to discharge.

Participants also completed the PC-PTSD during initial inpatient rehabilitation. Only 13.6% screened positive for PTSD; 19.8% endorsed the item pertaining to avoidance. Of those participants whose cause of injury was trauma, 33.3% met the cutoff for depression at admission, 11.1% met the cutoff for depression at discharge, and 17.8% screened positive for PTSD during initial inpatient rehabilitation. Compared with

participants whose cause of injury was non-traumatic, 48.6% met the cutoff for depression at admission, 16.2% met the cutoff for depression at discharge, and 8.3% screened positive for PTSD during initial inpatient rehabilitation. Thus, patients whose cause of injury was trauma had higher rates of PTSD, but lower rates of depression. There were no significant differences in depression and PTSD scores between participants with and without pressure ulcers during initial inpatient rehabilitation.

Participants were also placed into one of three categories based on whether they were above or below the cutoff for depression at discharge and whether they screened positive or negative for PTSD during initial inpatient rehabilitation (i.e., co-occurring depression and PTSD, either depression or PTSD, neither depression nor PTSD) to determine if these groups differed on any demographic or injury characteristics. The three groups were similar on demographic characteristics; however, differences were observed in injury level and time between the date of injury and admission to initial inpatient rehabilitation. Specifically, paraplegia was more common in the group of co-occurring depression and PTSD and in the group of either depression or PTSD, whereas tetraplegia was more common in the group of neither depression nor PTSD. Additionally, time since injury was shorter in the group of co-occurring depression and PTSD ( $M = 15.67$ ;  $SD = 15.5$ ) than in the group of either depression or PTSD ( $M = 38.08$ ;  $SD = 61.14$ ) and in the group of neither depression nor PTSD ( $M = 46.56$ ;  $SD = 53.15$ ).

## Associations with Pressure Ulcer Occurrence

Relations among injury-related and psychological variables and pressure ulcer occurrence were examined with  $\chi^2$  tests for association. Chi-square analyses revealed statistically significant associations between pressure ulcer occurrence and some injury-related and psychological variables. Injury level was found not to be statistically significantly associated with pressure ulcer occurrence during initial inpatient rehabilitation or pressure ulcer occurrence in the first 3 years post-discharge. However,  $\chi^2$  analyses revealed a statistically significant association between injury completeness and pressure ulcer occurrence during initial inpatient rehabilitation,  $\chi^2(3, n = 77) = 12.401, p = .006$ , Cramer's  $V = .4$ . Statistically significant associations were also present at year 1,  $\chi^2(3, n = 72) = 7.681, p = .053$ , Cramer's  $V = .33$ , year 2,  $\chi^2(3, n = 67) = 8.543, p = .036$ , Cramer's  $V = .36$ , and year 3,  $\chi^2(3, n = 63) = 6.416, p = .093$ , Cramer's  $V = .32$ . Specifically, throughout the study period, a greater proportion of participants whose injuries were classified as AIS D did not have pressure ulcers.

Admission depression status was not statistically significantly associated with pressure ulcer occurrence during initial inpatient rehabilitation or pressure ulcer occurrence in the first 3 years post-discharge. Although discharge depression status was not statistically significantly associated with pressure ulcer occurrence during initial inpatient rehabilitation or in the first 2 years post-discharge, there was a statistically significant association between pressure ulcer occurrence in year 3 and discharge depression status based on the recommended cutoff score of 10 on the PHQ-9,  $\chi^2(1, n = 67) = 5.279, p = .034$ , Cramer's  $V = .28$ . Specifically, a greater proportion of

participants who were depressed at discharge (71.4%) had a pressure ulcer in the third year post-discharge compared with participants who were not depressed at discharge (28.3%). Additionally, PTSD screen status was not statistically significantly associated with pressure ulcer occurrence at any time point, nor was endorsement of the PC-PTSD item pertaining to avoidance.

### **Survival Analysis**

Several life tables were constructed with one categorical factor considered at a time; Cox regression was also performed in order to consider multiple continuous factors simultaneously. These procedures were carried out first with the full sample of 82 veterans and later with a subsample of 40 veterans who did not have a pressure ulcer during inpatient rehabilitation. Of the full sample of 82 veterans, 51 developed a pressure ulcer during the study period. Following the examination of the full sample of 82 veterans, a subsample of 40 veterans who did not have a pressure ulcer during initial inpatient rehabilitation were studied. Although it is interesting to consider the sample as a whole, it is particularly important to understand the subsample of veterans who leave initial inpatient rehabilitation without a pressure ulcer, but may develop one in the first few years following discharge, potentially putting them at risk for developing additional pressure ulcers over time.

#### **Full sample results.**

*Demographic and injury characteristics.* Although injury level was not a statistically significant predictor, injury completeness was a statistically significant predictor of time to pressure ulcer ( $p < .05$ ). Median ulcer-free survival times were less

than a year for individuals whose injuries were classified as AIS A and B (.61 and .75 years, respectively), but over 2 years for individuals whose injuries were classified as AIS C or D (2.22 and 3.00 years, respectively). However, it is important to note that for all participants, the greatest number and proportion of terminal events occurred prior to discharge from initial inpatient rehabilitation, suggesting that all veterans, regardless of injury completeness classification, should be monitored closely during this time (see Table 1). That is, the risk of developing a pressure ulcer was greatest during initial inpatient rehabilitation for all veterans. Finally, neither the injury-related variable of LOC nor the demographic variables (i.e., gender, race/ethnicity, age, education) were statistically significant predictors of time to pressure ulcer.

None of the injury-related variables were statistically significant predictors of time to severe pressure ulcer (i.e., stage 3 or 4). Of the demographic variables, only race/ethnicity was a statistically significant predictor of time to severe pressure ulcer ( $p < .10$ ). Median severe ulcer-free survival times were better for African-American and Hispanic participants than for Caucasian participants. The greatest number and proportion of severe pressure ulcers for Caucasian participants occurred prior to discharge from initial inpatient rehabilitation, but this was not the case for African-American and Hispanic participants (see Table 2). Overall, African-American participants were least at risk for developing a severe pressure ulcer during the study period. This particular result seems to contrast with the findings of Guihan and colleagues (2008) whose study of demographic and injury characteristics associated with recurrence of severe pressure ulcers found that African-Americans had shorter severe



ulcer-free survival times after having had a previous severe pressure ulcer heal completely. However, it is important to note that the present study was concerned with the occurrence of the first severe pressure ulcer and did not examine recurrence of severe pressure ulcers.

***Depression.*** Admission depression status and discharge depression status were not statistically significant predictors of time to pressure ulcer or time to severe pressure ulcer in the full sample of 82 veterans. Admission depression score, discharge depression score, somatic depression item scores at admission and discharge, and non-somatic depression item scores at admission and discharge were not statistically significant predictors of time to pressure ulcer when entered into a Cox regression equation. Of these continuous indicators of depression, only somatic depression item scores at admission and discharge were statistically significant predictors of time to severe pressure ulcer ( $p < .10$ ). That is, there was a statistically significant trend for endorsement of somatic symptoms of depression at both admission ( $p = .095$ ; Hazard Ratio = 1.033; 95% CI, .994-1.074) and at discharge ( $p = .064$ ; Hazard Ratio = 1.042; 95% CI, .998-1.088) to predict severe ulcer-free survival. Veterans with higher scores on somatic items of depression had shorter severe ulcer-free survival times, whereas veterans who had lower scores were severe ulcer-free longer during the current study (see Table 3). In examining each somatic item individually, there was a statistically significant trend for endorsement of sleep disturbance at admission ( $p = .037$ ; Hazard Ratio = 1.339; 95% CI, 1.018-1.763) and appetite change at discharge ( $p = .057$ ; Hazard Ratio = 1.339; 95% CI, .991-1.809) to predict severe ulcer-free survival.

**Anxiety.** PTSD screen status and endorsement of the avoidance item were not statistically significant predictors of time to pressure ulcer or time to severe pressure ulcer in the full sample of 82 veterans. Additionally, PTSD screen score was not a statistically significant predictor of time to pressure ulcer or time to severe pressure ulcer when entered into a Cox regression equation.

### **Subsample results.**

**Demographic and injury characteristics.** Of the demographic and injury-related variables considered in the full sample, injury level was the only statistically significant predictor of time to pressure ulcer ( $p < .05$ ) as well as time to severe pressure ulcer ( $p < .05$ ) in the subsample of 40 veterans. The greatest number and proportion of terminal events occurred in the first year following discharge from initial inpatient rehabilitation (see Tables 4 and 5). That is, the risk of developing a pressure ulcer was greatest during the first year following discharge, which suggests that all veterans who did not have a pressure ulcer prior to discharge, regardless of injury level, should be monitored more closely during this time. Interestingly, only 11.5% of veterans with tetraplegia who did not have a pressure ulcer prior to discharge developed one in the first 3 years following discharge, whereas about 43% of veterans with paraplegia developed a pressure ulcer following discharge. In terms of time to severe pressure ulcer for veterans who did not have a pressure ulcer prior to discharge, those with paraplegia again were at greater risk, particularly in the first year following discharge.

**Depression.** Depression status at discharge was a statistically significant predictor ( $p < .05$ ) of time to pressure ulcer (see Table 6). The majority of the 40

veterans without a pressure ulcer during initial inpatient rehabilitation did not develop a pressure ulcer in the first 3 years following discharge. Of those who were not depressed at discharge, only 17% developed a pressure ulcer following discharge, whereas 60% of those who were depressed at discharge developed a pressure ulcer following discharge. Overall, the risk of developing a pressure ulcer following discharge from initial inpatient rehabilitation was greater for participants who were depressed at discharge.

Discharge depression score ( $p = 0.044$ ; Hazard Ratio = 1.098; 95% CI, 1.002-1.203) was also a statistically significant predictor of time to pressure ulcer. There was a statistically significant trend for endorsement of symptoms to predict ulcer-free survival, a finding that is consistent with the hypotheses of the present study. Veterans with higher scores on the PHQ-9 at discharge had shorter ulcer-free survival times, whereas veterans who had lower scores were ulcer-free longer in the time following discharge from inpatient rehabilitation (see Table 7).

Looking more closely at the PHQ-9, the total score at admission was not a statistically significant predictor, but the somatic items at admission ( $p = .047$ ; Hazard Ratio = 1.096; 95% CI, 1.001-1.199) were important in predicting ulcer-free survival times for veterans who did not have a pressure ulcer during inpatient rehabilitation. Additionally, although the total PHQ-9 score at discharge was a statistically significant predictor, the non-somatic symptoms at discharge ( $p = .02$ ; Hazard Ratio = 1.109; 95% CI, 1.017-1.210) were particularly important in predicting ulcer-free survival time for veterans who did not have a pressure ulcer during inpatient rehabilitation. Moreover, it was these two specific areas of the PHQ-9 at admission and discharge that were the only

statistically significant predictors of time to severe pressure ulcer in this subsample of veterans (see Table 8). Veterans with higher scores on the somatic items at admission ( $p = 0.03$ ; Hazard Ratio = 1.134; 95% CI, 1.012-1.270) and on the non-somatic items at discharge ( $p = .06$ ; Hazard Ratio = 1.102; 95% CI, .996-1.220) had shorter severe ulcer-free survival times. In looking at each somatic item individually, there was a statistically significant trend for endorsement of sleep disturbance at admission ( $p = .013$ ; Hazard Ratio = 2.752; 95% CI, 1.235-6.131) to predict ulcer-free survival. There was also a statistically significant trend for endorsement of sleep disturbance ( $p = .023$ ; Hazard Ratio = 3.832; 95% CI, 1.208-12.154) and poor energy ( $p = .076$ ; Hazard Ratio = 1.936; 95% CI, .932-4.018) at admission to predict severe ulcer-free survival.

**Anxiety.** PTSD screen score ( $p = .059$ ; Hazard Ratio = 1.451; 95% CI, .985-2.138) was a statistically significant predictor of time to pressure ulcer. There was a statistically significant trend for endorsement of symptoms to predict ulcer-free survival. Veterans with higher scores on the PC-PTSD had shorter ulcer-free survival times, whereas veterans who had lower scores were ulcer-free longer in the time following discharge from inpatient rehabilitation (see Table 7).

### **Summary of Results**

About 40% of participants met the cutoff for depression at admission, whereas less than 15% met the cutoff at discharge. This seems comparable to previous research showing that during inpatient SCI rehabilitation, about 25% of patients meet the criteria for major depressive disorder as measured by the PHQ-9 (Bombardier et al., 2012). Furthermore, there was a statistically significant improvement in total PHQ-9 depression

scores from admission to discharge ( $p < .0005$ ) in the present study. Admission depression status was not statistically significantly associated with pressure ulcer occurrence at any time point; the only time point at which discharge depression status was statistically significantly associated with pressure ulcer occurrence was during the third year post-discharge. The emergence of the statistically significant association between discharge depression status and pressure ulcer occurrence in the third year post-discharge seems to be consistent with Elliott's (1999) conclusion that it is more difficult to detect risk factors early on post-injury because pressure ulcer patterns have not yet developed and because the impact of factors such as depression may not be immediate.

In terms of PTSD, only 13.6% screened positive on the PC-PTSD; this is slightly lower than anticipated based on what has been established in the relevant literature. Specifically, research in the area of SCI and PTSD has shown that at admission to rehabilitation, prevalence of PTSD was 20% (Nielsen, 2003a); by 6 months post-injury, only 14% met the cutoff for PTSD (Kennedy & Evans, 2001). The prevalence of PTSD in a sample of individuals with SCI who were, on average, 12 years post-injury was 11% (Otis, Marchand, & Courtois, 2012), whereas in samples averaging 14 years post-injury (Nielsen, 2003b) and over 20 years post-injury (Krause, Saunders, & Newman, 2010), the prevalence was less than 10%. That is, the endorsement of PTSD symptoms in individuals with SCI seems to decrease as a function of time post-injury. However, it is important to note that in these studies, PTSD prevalence was determined through the use of more thorough assessment instruments in contrast with the 4-item screener utilized in the present study. In regards to the association of PTSD symptoms with pressure ulcer

occurrence, screen status (i.e., negative or positive) was not statistically significantly associated with pressure ulcer occurrence at any time point, nor was endorsement of the PC-PTSD item pertaining to avoidance.

The main analyses conducted for the present study were two types of survival analysis first carried out with the full sample of 82 veterans and later with a subsample of 40 veterans who did not have a pressure ulcer during inpatient rehabilitation. The results of these analyses provided partial support for the hypotheses that there would be statistically significant differences in time to pressure ulcer and time to severe pressure ulcer between veterans with and without depressive and anxious symptoms. The hypotheses were not fully supported in the full sample as the psychological variables were not statistically significant predictors of time to pressure ulcer. In predicting time to severe pressure ulcer, only somatic depression item scores at admission and at discharge were statistically significant predictors. Specifically, veterans with higher scores on somatic items of depression had shorter time intervals to onset of a severe pressure ulcer, whereas veterans who had lower scores remained severe ulcer-free longer during the current study.

In the subsample of 40 veterans who did not have a pressure ulcer during initial inpatient rehabilitation, the results again provided partial support for the hypotheses of the present study. Specifically, there was a statistically significant trend for endorsement of symptoms of depression and trauma-related anxiety to predict ulcer-free survival. Veterans with higher scores on both the PHQ-9 at discharge and the PC-PTSD had shorter time intervals to pressure ulcer onset, whereas veterans who had lower scores

remained ulcer-free longer in the time following discharge from inpatient rehabilitation. Looking more closely at the PHQ-9, the total score at admission was not a statistically significant predictor, but the somatic items at admission were of importance in predicting the length of the time interval to pressure ulcer onset for veterans who did not have a pressure ulcer during inpatient rehabilitation. Additionally, although the total PHQ-9 score at discharge was a statistically significant predictor, the non-somatic symptoms of depression at discharge were particularly important in predicting the length of the time interval to pressure ulcer onset for veterans who did not have a pressure ulcer during inpatient rehabilitation. Moreover, it was these two specific areas of the PHQ-9 at admission and discharge that were the only statistically significant predictors of time to severe pressure ulcer in this subsample of veterans. Veterans with higher scores on the somatic items at admission and on the non-somatic items at discharge had shorter time intervals to onset of a severe pressure ulcer.

## CHAPTER V

### CONCLUSIONS

The purpose of the present study was to fill in the gaps in the pressure ulcer risk factor literature. Prediction and subsequent prevention of pressure ulcers is important because pressure ulcers are often associated with fatal cases of septicemia in individuals with SCI (National Spinal Cord Injury Statistical Center, 2012). It is estimated that pressure ulcers are the cause of death for about 8% of individuals with SCI. Even pressure ulcers of a less severe nature impair functional ability and have the potential to prevent individuals with SCI from pursuing educational and vocational goals (McKinley et al., 1999). It is estimated that pressure ulcers account for 25% of the total cost of caring for individuals with SCI, totaling about \$1.2 billion each year (Byrne & Salzberg, 1996). VA health care costs are \$73,021 higher each year for veterans with a pressure ulcer in that year, which amounts to over \$89 million in additional costs for the health care system. Overall, annual treatment costs are over 260% higher for SCI patients who have pressure ulcers (Stroupe et al., 2011). It has been asserted that the cost of preventing pressure ulcers is far less than the cost of treatment (Richards et al., 2004). Specifically, interventions that cost \$8,000 or less per patient would ultimately be cost-saving for the VA and would decrease the burden of illness experienced by veterans with pressure ulcers (Stroupe et al., 2011).

Although over 200 pressure ulcer risk factors have been identified and studied, more research has been needed in the area of psychological predictors (Gelis et al.,



2009). Commonly measured risk factors (e.g., demographics, injury characteristics) may or may not be helpful in identifying individuals with SCI who are at risk of developing pressure ulcers, but more importantly, they cannot be modified. It is important to focus on risk factors that are amenable to treatment, which is one reason why some researchers have chosen to explore psychological risk factors for pressure ulcers (Sheppard et al., 2006). Research in this area began in 1979 with the work of Anderson and Andberg who asserted that prevention of pressure ulcers depends on the individual's ability to be proactive in taking care of his or her skin. The results of their research revealed that the psychological variable of satisfaction with life activities explained the greatest amount of variance in recent pressure ulcer history (Anderson & Andberg, 1979).

Depression has been the central focus in the area of psychological risk factors, with early research revealing an association between depression and difficulty learning and performing self-care during inpatient SCI rehabilitation (Malec & Neimeyer, 1983). Continued research examined more directly the potential relation between depression and pressure ulcer occurrence and severity, yielding useful results that can inform future research. To begin with, time since injury seems to play an important role because the odds of developing pressure ulcers significantly increase with time post-injury (Chen et al., 2005). Moreover, it may be more difficult to detect risk factors early on post-injury because pressure ulcer patterns have not yet developed and because the impact of factors such as depression may not be immediate. This explains why in a study of the first year post-injury, depression was not predictive of pressure ulcer diagnosis at the annual evaluation (Elliott, 1999), but in a one-year study of individuals with a wider range of

time post-injury (i.e., less than a year to over 40 years), individuals with pressure ulcers were found to have higher levels of depression (Herrick, Elliott, & Crow, 1994b). Similarly, increased depression was shown to be associated with increased likelihood of pressure ulcer development in a sample whose time since injury ranged from 1 year to 10 years (Sheppard et al., 2006). Furthermore, in a study of veterans who were at least 20 years post-injury, those with frequent depressive symptoms (i.e., 14 or more days of depressive symptoms in the past month) were 30% more likely to report having had a pressure ulcer (Smith et al., 2008). Additionally, research has shown that the longer the time since injury onset, the greater the influence of depression on pressure ulcer severity (Martz et al., 2010).

Another important consideration is the methodology of the research conducted. Although Krause and Broderick (2004) found depressive symptoms to be a significant risk factor for recurrent pressure ulcers in a sample of individuals at least 5 years post-injury, they had asked their participants to self-report their pressure ulcer history as opposed to following them over time. Thus, they recommended that longitudinal designs be employed in future research. January and colleagues (2014) followed a pediatric-onset SCI sample for 17 years, revealing that individuals with depression, but not anxiety, were at greater risk for developing pressure ulcers. Interestingly, individuals with anxiety were more integrated and participatory in the community than were individuals with depression. The only other research conducted on anxiety as a potential explanatory factor found that increased anxiety was associated with less likelihood of developing pressure ulcers, but this was a cross-sectional study (Sheppard

et al., 2006), which has not been uncommon. In fact, most of the research conducted on secondary complications of SCI has been cross-sectional in nature. This is problematic because results of cross-sectional studies often conflict with results from longitudinal studies (Coll, 2007). The researchers who conducted the 17-year longitudinal study asserted that cross-sectional designs cannot account for how mental health issues may relate to secondary conditions over time (January et al., 2014), and they are not alone in concluding that longitudinal research is needed in order to detect the effects of risk factors on secondary complications over time (Coll, 2007).

Thus, the present study was conducted to extend previous research by utilizing a longitudinal design to continue the study of depression as a pressure ulcer risk factor while also contributing to the limited understanding of anxiety as a potential protective factor. Specifically, time to pressure ulcer occurrence and time to severe pressure ulcer occurrence were examined in a sample of veterans with SCI during initial inpatient rehabilitation and in the first 3 years post-discharge with an emphasis on the explanatory role of depression and anxiety. In the present study, the incidence of pressure ulcers was 62%, which was higher than anticipated based on previous research conducted at the MEDVAMC, where the present study was conducted, which indicated that almost 39% were treated for at least one pressure ulcer during the 3-year study period (Garber & Rintala, 2003). However, it should be noted that the estimated prevalence and incidence of pressure ulcers in individuals with SCI vary across studies with most research reporting that the incidence of pressure ulcers in the first 5 years after injury is at least 30% (Richards et al., 2004). Of the full sample of 82 veterans, 42 had a pressure ulcer

during rehabilitation, some of which developed during rehabilitation, whereas for other patients, the pressure ulcer likely developed before being admitted for initial inpatient rehabilitation.

Admission depression status was not statistically significantly associated with pressure ulcer occurrence at any time point; the only time point at which discharge depression status was statistically significantly associated with pressure ulcer occurrence was during the third year post-discharge. The emergence of the statistically significant association between discharge depression status and pressure ulcer occurrence in the third year post-discharge seems to be consistent with Elliott's (1999) conclusion that is more difficult to detect risk factors early on post-injury because pressure ulcer patterns have not yet developed and because the impact of factors such as depression may not be immediate.

Contrary to limited research showing that individuals with anxiety are less likely to develop pressure ulcers (January et al., 2014; Sheppard et al., 2006), PTSD screen status (i.e., negative or positive) was not statistically significantly associated with pressure ulcer occurrence at any time point, nor was endorsement of the PC-PTSD item pertaining to avoidance. One possible explanation for the inconsistent results is the specific instruments used to assess anxiety in the two studies previously conducted and the present study. The present study used the PC-PTSD, a brief screener consisting of four items pertaining to posttraumatic stress, whereas January and colleagues (2014) used the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) and Sheppard and colleagues (2006) used the seven anxiety items of the 14-item Hospital

Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983), two measures of general anxiety. Although PTSD was classified as an anxiety disorder in the DSM-III and DSM-IV, in the DSM-5 it is classified in a new category: trauma and stressor-related disorders (American Psychiatric Association, 2013). Thus, it may not be appropriate to compare the PTSD-related results of the present study with the results of previous research on anxiety and pressure ulcer occurrence. Interestingly, it was recently suggested that future research distinguish between general anxiety and PTSD in the study of SCI and secondary complications (January et al., 2014).

Survival analysis was utilized to examine the explanatory role of depression and anxiety in predicting the length of the time interval to pressure ulcer onset for the duration of the study period in both the full sample of 82 veterans and the subsample of 40 veterans who did not have a pressure ulcer during initial inpatient rehabilitation. It was of interest to study this subsample because it is difficult to know which veterans who did not have a pressure ulcer during initial inpatient rehabilitation may be at risk and should be followed after discharge. The results of the survival analyses provided partial support for the hypotheses that there would be statistically significant differences in time to pressure ulcer and time to severe pressure ulcer between veterans with and without symptoms of depression and anxiety. In the full sample, the psychological variables were not statistically significant predictors of time to pressure ulcer. In predicting time to severe pressure ulcer, only somatic depression item scores at admission and at discharge were statistically significant predictors. Specifically, veterans with higher scores on somatic items of depression had shorter time intervals to

onset of a severe pressure ulcer, whereas veterans who had lower scores remained severe ulcer-free longer during the current study.

The three somatic symptoms within the PHQ-9 (i.e., sleep disturbance, poor energy, appetite change) may serve as predictors of the length of the time interval to onset of a severe pressure ulcer because of their association with other relevant factors. For example, nutrition is an established risk factor for pressure ulcer occurrence (Byrne & Salzberg, 1996); appetite change, one of the somatic symptoms, likely carries with it changes in nutrition and the potential for malnutrition, putting patients at risk for developing more severe pressure ulcers. The role of sleep disturbance may not be as clear because the PHQ-9 item pertaining to sleep disturbance does not distinguish between sleeping too little and sleeping too much, which could have differing implications. However, it is possible that sleep disturbance, as well as poor energy, could explain the association between depression in individuals with SCI and fewer hours out of bed, fewer days out of the house, less engagement in productive activities, and less planned exercise (Saunders et al., 2012; Tate et al., 1994). This concept is supported by research showing that greater participation is associated with lower somatic symptoms of depression in individuals with SCI (Hartoonian et al., 2014). Knowing that planned exercise is significantly associated with fewer pressure ulcers over time (Krause & Broderick, 2004), it seems plausible that somatic symptoms of depression could play an important role within behavioral models, such as the model created by Krueger and colleagues (2013), to explore the relation between depressive symptoms and the occurrence of secondary conditions, specifically severe pressure ulcers.

In the subsample of 40 veterans who did not have a pressure ulcer during initial inpatient rehabilitation, there was a statistically significant trend for endorsement of symptoms of depression and trauma-related anxiety to predict ulcer-free survival. Veterans with higher scores on the PHQ-9 at discharge and on the PC-PTSD had shorter time intervals to pressure ulcer onset, whereas veterans who had lower scores remained ulcer-free longer in the time following discharge from inpatient rehabilitation. The finding that higher depression scores predicted shorter time intervals to pressure ulcer onset is consistent with the hypotheses of the present study, whereas the finding that higher PTSD scores also predicted shorter time intervals to pressure ulcer onset is not. However, as described earlier, with the change in classification of PTSD from an anxiety disorder to a trauma disorder in the DSM-5 (American Psychiatric Association, 2013), it may not be appropriate to consider the PC-PTSD a measure of anxiety, potentially explaining why these results are not in line with hypotheses. As is the case with general anxiety, the existing research on PTSD and pressure ulcer occurrence is incredibly limited. Although psychological diagnoses were not considered as predictors of pressure ulcer occurrence, in a two-year study of veterans with SCI, only 5.7% of those with PTSD had a pressure ulcer, compared with 11.4% of veterans with anxiety and 31.7% of veterans with depression (Banerjea, Findley, Smith, Findley, & Sambamoorthi, 2009). It is possible that additional research will come in the future due to the prevalence of PTSD in veterans with SCI returning from Iraq and Afghanistan as well as its tendency to delay participation in rehabilitation until symptoms are managed sufficiently (Weaver et al., 2009).

What may explain the results showing that both depression scores and PTSD scores predicted shorter time intervals to pressure ulcer onset could be the presence of cognitive and affective symptoms in both disorders. Specifically, research has shown that for some individuals, the depressed mood associated with PTSD is more salient than the anxiety symptoms (Friedman et al., 2011). Moreover, the comorbidity between PTSD and depression ranges from 9% all the way to 31% in soldiers returning from combat (Thomas et al., 2010). The new symptom clusters in the DSM-5 seem to acknowledge this; specifically, re-experiencing/intrusion and arousal/reactivity remain, whereas avoidance/numbing has been split into two new clusters: avoidance and negative alterations in cognitions and mood (American Psychiatric Association, 2013). Several PTSD assessment instruments have already been updated to reflect the new DSM-5 criteria; the PC-PTSD is still under revision.

Looking more closely at the PHQ-9 in the subsample of 40 veterans, the total score at admission was not a statistically significant predictor, but the somatic items at admission were of importance in predicting shorter time intervals to pressure ulcer onset for veterans who did not have a pressure ulcer during inpatient rehabilitation. Additionally, although the total PHQ-9 score at discharge was a statistically significant predictor, the non-somatic symptoms of depression at discharge were particularly important in predicting time intervals to pressure ulcer onset for veterans who did not have a pressure ulcer during inpatient rehabilitation. Moreover, it was these two specific areas of the PHQ-9 at admission and discharge that were the only statistically significant predictors of time to severe pressure ulcer in this subsample of veterans. Veterans with



higher scores on the somatic items at admission and on the non-somatic items at discharge had shorter time intervals to onset of a severe pressure ulcer post-discharge. These results indicate that it may be helpful to target somatic symptoms during rehabilitation. For example, it has been suggested that treatment focusing on increasing participation could have a positive effect on somatic symptoms of depression in individuals with SCI (Hartoonian et al., 2014). Following rehabilitation, the focus could shift to treating non-somatic symptoms as part of monitoring and following up with veterans who did not have a pressure ulcer during rehabilitation, but may develop one soon after discharge.

### **Limitations and Future Research**

It is important to note the limitations of the present study, including a relatively short study period and the restrictions that accompany archival data. As detailed earlier, research has shown that time since injury is a factor in studying predictors of pressure ulcer occurrence and severity. It has been suggested that it takes time for pressure ulcer patterns to develop, meaning that the longer the study period, the more likely it is that these patterns have been established and that predictors can be detected. Although the present study included initial inpatient rehabilitation as well as the first 3 years following discharge, it is recommended that future research employ a more extended study period, such as the 17-year study period used by January and colleagues (2014). Collection of psychological data in the SCI Care Line at the MEDVAMC began on January 1, 2008. Future research can build upon the design of the present study by following veterans over a span of 5 or 10 years, for example. Knowing the impact pressure ulcers have on

quality of life and cost of care, it will prove invaluable to continue conducting longitudinal research on modifiable risk factors.

Along with following participants for a longer period of time, it would also be beneficial to include additional social and psychological variables that may explicate the relation between depressive symptoms and the occurrence of secondary conditions, such as community participation and appraisals of disability. The Craig Handicap Assessment and Recording Technique (CHART; Whiteneck, Charlifue, Gerhart, Overholser, & Richardson, 1992) is a measure that assesses community participation, independence, and activity level and has been used in previous research (Fuhrer et al., 1993; Garber et al., 2000; January et al., 2014). The CHART includes six subscales (Physical Independence, Cognitive Independence, Mobility, Occupation, Social Integration, and Economic Self-Sufficiency) with higher scores indicating greater integration and participation in the community. Research has shown that community-residing individuals with SCI with lower scores on the Occupation and Mobility subscales had more severe pressure ulcers (Fuhrer et al., 1993). Occupation was also an area of severe impairment in another sample of individuals with SCI; individuals without pressure ulcers had higher scores on the Independence, Mobility, and Economic Self-Sufficiency dimensions (Garber et al., 2000).

Taking a different approach to utilizing the CHART, January and colleagues (2014) found that individuals with SCI who were depressed were less likely to be integrated into the community due to impairments in the areas of Economic Self-Sufficiency, Occupation, and Mobility. Interestingly, they examined depression as a

predictor of scores on the CHART subscales as well as of pressure ulcer occurrence, but did not explore the potential for the CHART dimensions to predict pressure ulcer occurrence. The results of these three studies suggest that the CHART is a unique and useful instrument and that further research is needed to reveal what role community participation, independence, and activity level play in predicting pressure ulcer occurrence and severity.

The CHART was not available for analysis in the present study due to the use of archival data and the resulting restriction to psychological measures administered during initial inpatient rehabilitation, such as the PHQ-9 and the PC-PTSD. More recently, SCI psychologists at the MEDVAMC have added to their battery of brief self-report psychological measures the Appraisals of Disability: Primary and Secondary Scale short-form (ADAPSS-sf), which is based on the full-length version of the Appraisals of Disability: Primary and Secondary Scale (ADAPSS; Dean & Kennedy, 2009). They have studied the short form of this established measure in a sample of 98 veterans who were, on average, 18 years post-injury. Their results revealed a two-factor structure (fear/loss and resilience) that is consistent with the full ADAPSS, as well as several other interesting findings. Specifically, the ADAPSS-sf was associated with the PHQ-9, but not with time since injury. Additionally, lower injury level and more preserved physical function did not protect against less adaptive appraisals (Mignogna, Christie, Holmes, & Ames, 2015). The ADAPSS-sf shows promise and its continued use is likely to yield more useful information that can be utilized to improve health care for individuals with SCI.

Moreover, both the CHART and the ADAPSS-sf could fit nicely into the conceptual model created by Krueger and colleagues (2013). In their conceptual model, depression causes the elevated occurrence of physical complications in individuals with SCI through proximate mechanisms (i.e., non-adherence to rehabilitation and self-management training, substance abuse), intermediate mechanisms (i.e., compromised beliefs/knowledge regarding self-management, potential physical capacity not realized, potential functional capability not achieved, limited use of assistive resources), and the ultimate mechanism of poor adherence to self-management behaviors (Krueger et al., 2013). The present study took a global approach to the model, examining only the “cause” (depression) and “effect” (the specific physical complication of pressure ulcers). However, future research could focus on specific component mechanisms within the overall model. Specifically, researchers could utilize dimensions of the CHART as a proxy for the ultimate mechanism of poor adherence to self-management behaviors, which corresponds with the ICF category of activities, and the intermediate mechanism of limited use of assistive resources, which corresponds with participation. The other intermediate mechanisms could be measured with items of the ADAPSS-sf, which asks participants to rate the extent to which each statement reflects their current perceptions of their injury. For example, the item that assesses negative perceptions of disability could measure compromised beliefs and knowledge regarding self-management. The item that assesses personal agency could measure achievement of potential functional capability. Finally, the item that assesses determined resolve could measure realization of potential physical capacity.

Additional limitations of the present study include missing data, potential sampling bias, and attrition. In order to prevent these limitations from occurring in future research, three recommendations should be made based on the issues encountered during the present study. First, it is recommended that all veterans complete the brief psychological measures prior to discharge from initial inpatient rehabilitation. Second, it is recommended that brief psychological measures be administered at home VA hospitals for veterans who cannot travel long distances within the hub and spoke model of the VA Health Care System for annual evaluations. Third, it is recommended that continued use of VA SCI care be encouraged through follow-up phone calls to veterans and grouping of appointments. For veterans with limited access to transportation to their home VA hospital, long-distance technologies should be used to provide these veterans with opportunities to discuss their physical and mental health concerns with VA SCI providers who have specialized knowledge and can make appropriate recommendations and referrals as necessary.

### **Improving Health Care for Individuals with SCI**

Despite the limitations of the present study, the results do possess important practical implications for SCI-related health care. Behavioral medicine research has indicated that if an individual has psychological issues, his or her adherence to health behavior recommendations has the potential to be compromised. That is, although psychological risk factors are often overlooked, they need to be assessed and treated as part of the effort to prevent pressure ulcers and their recurrence. Specifically, psychological distress interferes with cooperation and is associated with inactivity, self-

neglect, and poor medical adherence (Consortium for Spinal Cord Medicine, 2000). It has been asserted that research should be conducted within a framework that focuses on treating depression as a means of improving health care for individuals with SCI (Krueger et al., 2013). The present study provides support for this notion that treating depression, as well as PTSD, in individuals with SCI is a critical component of the overall continuum of care, including the prevention of pressure ulcers.

Pressure ulcers are considered a preventable secondary condition because it is theorized that they develop when self-care and other preventive health behaviors (e.g., weight shifts, skin checks) are lacking (Anderson & Andberg, 1979). However, research results conflict as to whether or not there is an association between preventive health behaviors and pressure ulcer occurrence (Krause & Broderick, 2004; Krause et al., 2001). Specifically, daily skin monitoring has been found to serve as a significant protective factor in the development of pressure ulcers, but research on other preventive health behaviors (e.g., weight redistribution, regular repositioning in bed) has been limited by cross-sectional designs, making it difficult to determine if they also serve as protective factors (Gelis et al., 2009).

Various educational interventions have been developed to teach individuals with SCI preventive health behaviors specific to skin care and pressure ulcer prevention. Those that have been found to be effective include a formal pressure ulcer clinic offering individualized education with an emphasis on patient and family responsibility for pressure ulcer prevention (Krouskop, Noble, Garber, & Spencer, 1983), and an individualized educational intervention with monthly structured follow-ups via

telephone for 2 years (Rintala et al., 2008). An interactive web-based program has also been developed, but its effectiveness has yet to be studied (Hilgart et al., 2014). A program combining self-management groups and individual motivational interviewing telephone calls did not improve skin care behaviors or pressure ulcer outcomes (Guihan et al., 2014).

It has been concluded that focusing solely on teaching preventive health behaviors may not be effective in reducing pressure ulcer recurrence. Therefore, attention also should be paid to affective states that likely affect the performance of preventive health behaviors (Krause, 1998; Krause & Broderick, 2004). An integral part of this process is to ensure that best practices are implemented when assessing affective states, such as depression. Elliott (2015) asserts that assessment must be done on both an inpatient and outpatient basis as a means of identifying which individuals may benefit from treatment. The PHQ-9 has demonstrated good sensitivity and specificity among individuals with SCI, suggesting that this instrument would be appropriate for evidence-based assessment of depression. However, the VA does not have a national standardized approach to assessing for depression during initial inpatient SCI rehabilitation or at annual psychosocial evaluations for veterans with SCI. Additionally, the SCI Model Systems use a single item during inpatient rehabilitation (“Has a health professional told you that you have depression?”). Therefore, a disconnect remains between the best available evidence and current practice. Elliott (2015) poses the question of how much more evidence will be needed before systems providing SCI care will implement use of assessment measures, such as the PHQ-9, that are reliable and valid when utilized in SCI

samples and provide useful information about which individuals may benefit from treatment.

Individuals with SCI whose assessment results indicate that they may benefit from treatment should then be provided with opportunities to engage in evidence-based treatments. The VA provides evidence-based treatments for both depression and PTSD, all of which are supported by clinical research and focus on the relationship between thoughts, emotions, and behaviors. Cognitive Behavioral Therapy (CBT) and Acceptance and Commitment Therapy (ACT) are the two evidence-based treatments for depression. The goal of CBT is to help veterans learn new patterns of thinking and new positive behaviors as a means of decreasing depression, whereas ACT enables veterans to overcome worry and pain and take active steps to achieve what matters most to them. The two evidence-based treatments for PTSD are Cognitive Processing Therapy (CPT) and Prolonged Exposure Therapy (PE). CPT helps veterans learn about how going through trauma has changed how they think about and look at the world, themselves, and others, which then affects how they feel and behave. PE focuses on approaching trauma-related thoughts, feelings, and situations that veterans have been avoiding due to the distress they cause; repeated exposure helps reduce the power they have to cause distress (Department of Veterans Affairs, 2015).

As detailed earlier, interventions that cost \$8,000 or less per patient would ultimately be cost-saving for the VA and would decrease the burden of illness experienced by veterans with pressure ulcers (Stroupe et al., 2011). For veterans receiving mental health services, the average amount spent by the VA is \$3,702



(Department of Veterans Affairs, 2014); the average treatment cost per veteran for PTSD or depression is only \$2,282 (National Council for Behavioral Health, 2012). This suggests that additional interventions, such as educational skin-care programs, could also be included without exceeding the \$8,000 mark. Providing mental health services prior to discharge from initial inpatient rehabilitation has the potential to improve both mental and physical health for veterans with SCI. Thus, beyond saving the VA health care system millions of dollars, the findings of the present study are also just as important at the individual level as they possess the potential to improve both quality of care and quality of life for veterans and civilians alike.

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## APPENDIX

Figure 1.

*Rate of Depression at Admission and Discharge*

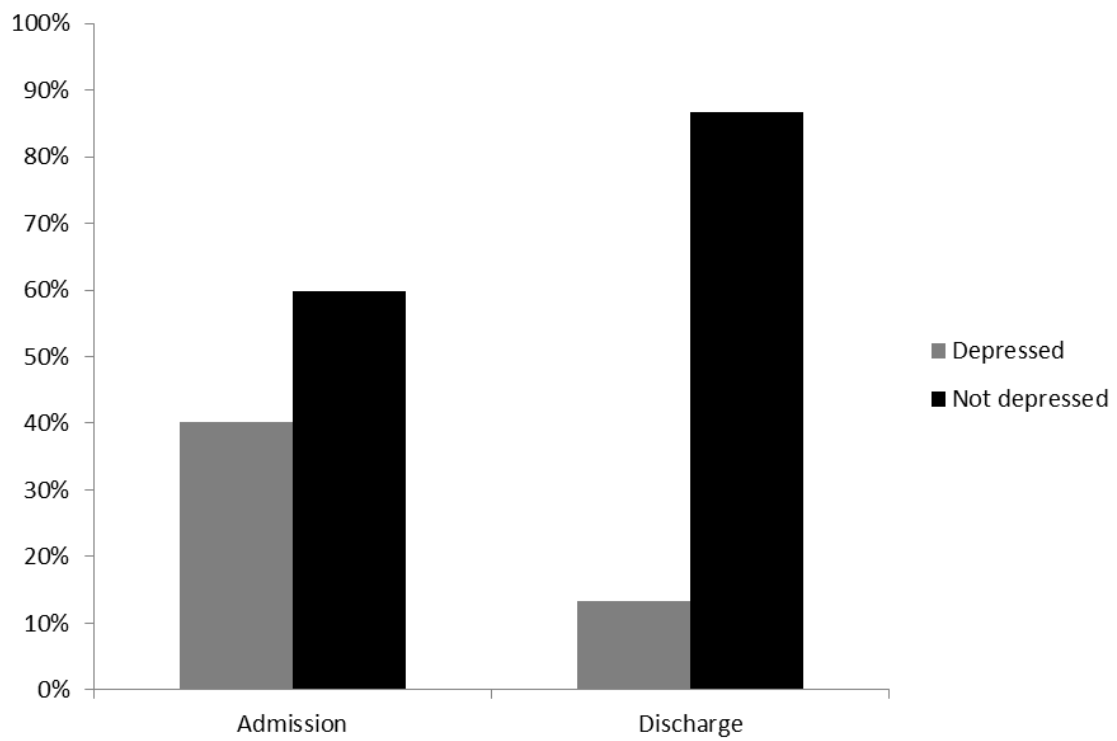




Table 1.

*Life Table Analysis Assessing Injury Completeness in Predicting Time to Pressure Ulcer*  
( $n = 82$ )

AIS	Interval Start Time	Exposed to Risk	Terminal Events	Hazard Rate
D	0	33	11	.40
	1	21	4	.21
	2	16.5	0	.00
	3	8.5	1	.00
C	0	17	8	.62
	1	8.5	0	.00
	2	8	2	.29
	3	3	0	.00
B	0	9	6	1.00
	1	3	1	.40
	2	2	0	.00
	3	1	0	.00
A	0	17	14	1.4
	1	3	0	.00
	2	3	1	.40
	3	1	0	.00

Table 2.

*Life Table Analysis Assessing Race/Ethnicity in Predicting Time to Severe Pressure Ulcer (n = 82)*

Race/Ethnicity	Interval Start Time	Exposed to Risk	Terminal Events	Hazard Rate
Caucasian, Non-Hispanic	0	49.5	15	.36
	1	31	9	.34
	2	20	2	.11
	3	9.5	1	.00
African- American	0	24.5	3	.13
	1	21	1	.05
	2	19	3	.17
	3	8	1	.00
Hispanic	0	6	1	.18
	1	5	2	.50
	2	3	0	.00
	3	1.5	0	.00

Table 3.

*Cox Regression Analyses Assessing Psychological Variables in Predicting Time to Severe Pressure Ulcer (n = 82)*

Explanatory variables	Hazard ratio	95% Confidence Interval	<i>P</i>
Admission somatic depression	1.033	.994-1.074	.095
Discharge somatic depression	1.042	.998-1.088	.064

Table 4.

*Life Table Analysis Assessing Injury Level in Predicting Time to Pressure Ulcer (n = 40)*

Injury Level	Interval Start Time	Exposed to Risk	Terminal Events	Hazard Rate
Paraplegia	0	14	0	.00
	1	14	3	.24
	2	11	2	.20
	3	5	1	.00
Tetraplegia	0	25	0	.00
	1	23.5	2	.09
	2	20.5	1	.05
	3	9.5	0	.00

Table 5.

*Life Table Analysis Assessing Injury Level in Predicting Time to Severe Pressure Ulcer (n = 40)*

Injury Level	Interval Start Time	Exposed to Risk	Terminal Events	Hazard Rate
Paraplegia	0	14	0	.00
	1	13.5	2	.16
	2	11	1	.10
	3	6	2	.00
Tetraplegia	0	25	0	.00
	1	23.5	1	.04
	2	21.5	1	.05
	3	10	0	.00

Table 6.

*Life Table Analysis Assessing Discharge Depression Status in Predicting Time to Pressure Ulcer (n = 40)*

Discharge Depression	Interval Start Time	Exposed to Risk	Terminal Events	Hazard Rate
Not Depressed	0	34.5	0	.00
	1	33.5	4	.13
	2	28.5	2	.07
	3	13	0	.00
Depressed	0	4.5	0	.00
	1	4	1	.29
	2	3	1	.40
	3	1.5	1	.00

Table 7.

*Cox Regression Analyses Assessing Psychological Variables in Predicting Time to Pressure Ulcer (n = 40)*

Explanatory variables	Hazard ratio	95% Confidence Interval	<i>P</i>
Discharge depression	1.098	1.002-1.203	.044
Admission somatic depression	1.096	1.001-1.199	.047
Discharge non-somatic depression	1.109	1.017-1.210	.020
PTSD	1.451	.985-2.138	.059

Table 8.

*Cox Regression Analyses Assessing Psychological Variables in Predicting Time to Severe Pressure Ulcer (n = 40)*

Explanatory variables	Hazard ratio	95% Confidence Interval	<i>P</i>
Admission somatic depression	1.134	1.012-1.270	.030
Discharge non-somatic depression	1.102	.996-1.220	.060